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Biological Services Program

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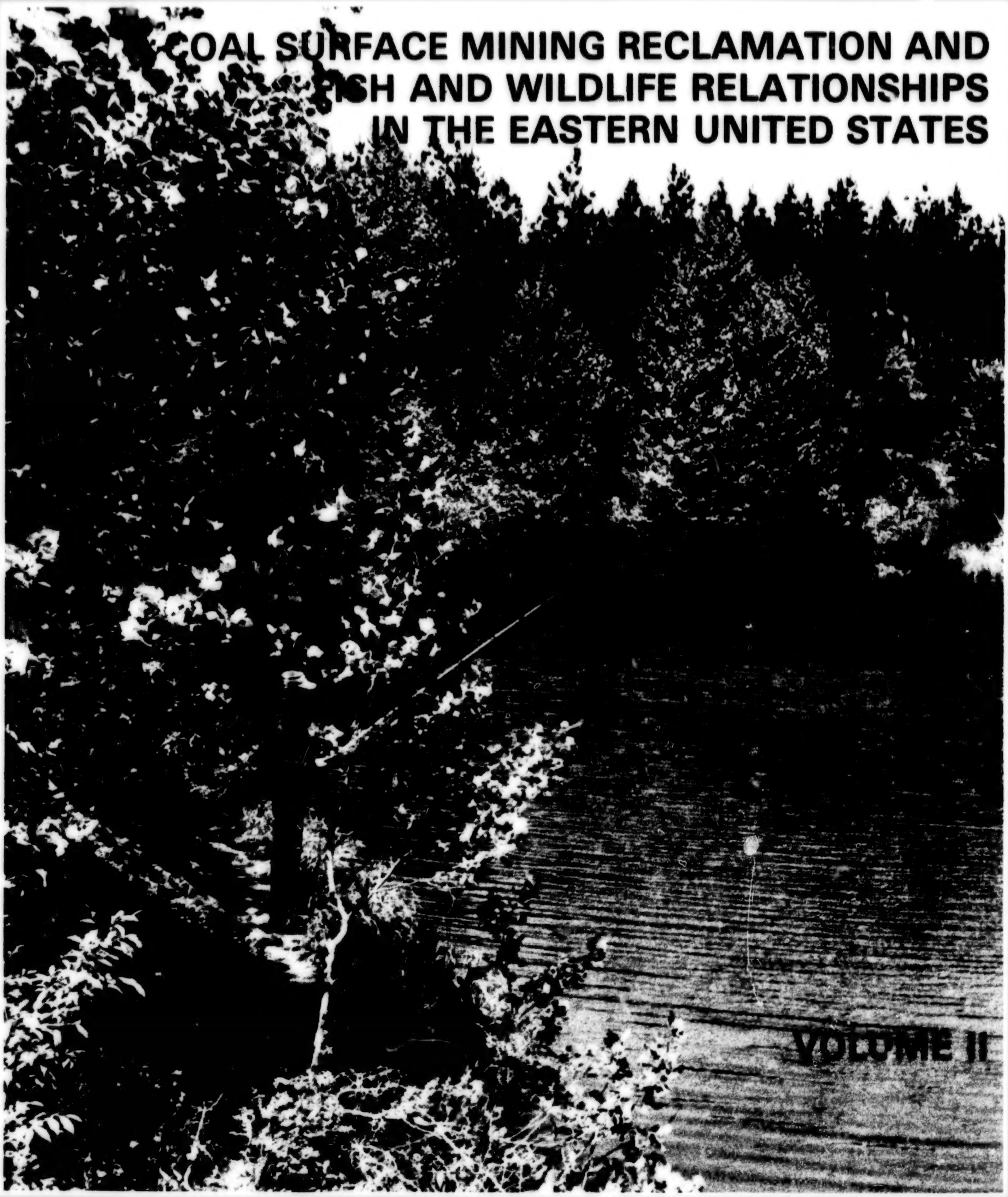
COAL SURFACE MINING RECLAMATION AND FISH AND WILDLIFE RELATIONSHIPS IN THE EASTERN UNITED STATES



VOLUME II

Fish and Wildlife Service

U.S. Department of the Interior

2460

The Biological Services Program was established within the U.S. Fish and Wildlife Service to supply scientific information and methodologies on key environmental issues that impact fish and wildlife resources and their supporting ecosystems.

Projects have been initiated in the following areas: coal extraction and conversion; power plants; mineral development; water resource analysis, including stream alterations and western water allocation; coastal ecosystems and Outer Continental Shelf development; environmental contaminants; National Wetland Inventory; habitat classification and evaluation; inventory and data management systems; and information management.

The Biological Services Program consists of the Office of Biological Services in Washington, D.C., which is responsible for overall planning and management; National Teams, which provide the Program's central scientific and technical expertise and arrange for development of information and technology by contracting with States, universities, consulting firms, and others; Regional Teams, which provide local expertise and are an important link between the National Teams and the problems at the operating level; and staff at certain Fish and Wildlife Service research facilities, who conduct inhouse research studies.

Cover:

In Kentucky more than 340,000 fish have been released in 409 strip mine lakes like this one. These lakes are open to the public and are a true fisherman's paradise. In Ohio county they are still talking about the award-winning 12-pound bass caught in a reclaimed mine lake in 1966.

(Photo, National Coal Association, 1967)

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UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

EASTERN ENERGY AND LAND USE TEAM
Route 3, Box 44
Kearneysville, West Virginia 25430

July 6, 1981

Dear Colleague:

The Eastern Energy and Land Use Team (EELUT) is pleased to provide you with a two volume set of a general reference manual: "Coal Surface Mining and Fish and Wildlife Relationships in the Eastern United States" Volume 1 "Past findings, the Surface Mining Law of 1977 (P. L. 95-87), Future Planning and Management Considerations, and Information Sources" FWS/OBS 80/24, and Volume 2 "Opportunities and Approaches for Fish and Wildlife Planning and Management in Coal Surface Mining, Reclamation, and Post-Mining Land Use" FWS/OBS-80/25. This product has been over two years in preparation by the author, Dr. Dan Leedy, Urban Wildlife Research Center, Columbia, Maryland.

Volume 1 contains abundant information on the past effects of coal surface mining on fish and wildlife populations. Sources of information for planning and assistance for reclamation activities are provided. Volume 2 provides the reader with special fish and wildlife management insights. In addition, Bob Hines, FWS Artist, depicts representative case examples for developing good fish and wildlife habitat for area, contour and mountaintop removal mining practices.

We are interested in your evaluation of this document and suggestions for future EELUT products.

Sincerely,

Edgar A. Pash

Edgar A. Pash
Team Leader, EELUT

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FWS/OBS-80/25
January 1981

COAL SURFACE MINING RECLAMATION AND FISH AND WILDLIFE RELATIONSHIPS IN THE EASTERN UNITED STATES

Volume II

OPPORTUNITIES AND APPROACHES FOR FISH AND WILDLIFE PLANNING AND MANAGEMENT IN COAL SURFACE MINING RECLAMATION AND POSTMINING LAND USES

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PREFACE

This is Volume II of a two-volume reference manual on coal surface mining and reclamation and fish and wildlife relationships in the eastern United States. Volume I summarizes much of the literature on environmental effects of surface mining and the responses of fish and wildlife to the altered habitat. The volume provides an overview of the "Surface Mining Control and Reclamation Act of 1977" (P.L. 95-87), including a brief account of the roles of various federal and state agencies, landowners and coal mine operators, other organizations and the public in implementing the Act; identifies other environmental laws related to surface mining; and suggests sources of information for planning and management. Volume I is a source book designed for readers interested in findings regarding surface mining-fish and wildlife relationships and in locating sources of assistance and information needed for preparing mining permit-reclamation plan applications with particular reference to fish and wildlife. Methodologies are not described in detail in Volume I. However, numerous references dealing with methodologies are cited.

Volume II is intended primarily for use by reclamation planners and managers as a general reference document. It also may be useful to coal mine operators, landowners, farmers, administrators, and other individuals or groups, such as sportsmen's clubs interested in protecting, enhancing, and managing fish and wildlife on surface-mined lands in the East. It identifies some of the opportunities for fish and wildlife planning and management in connection with various methods of surface mining for coal and the reclamation and management of surface-mined lands. It suggests approaches for management to enhance fish and wildlife in different regions and under different conditions, using real-life or hypothetical case examples. It further illustrates what productive habitat for various kinds of wild animal communities looks like at different stages of development. Appendices in Volume II illustrate a worksheet used for assigning reclamation priority and main benefits for SCS-related projects, identify plant species and provide sources of planting stock and seed for habitat development on surface-mined areas, and list contacts for obtaining fish for stocking impoundments.

Although this volume is designed as a primer to be useful alone, many readers may wish to obtain copies of other publications which complement the information provided here. These include Volume I, as described above, and: *Mined Land Reclamation for Fish and Wildlife,* a brief brochure, illustrated in color (FWS/OBS-78/95); and *A Guide for Vegetating Surface-Mined Lands for Wildlife in Eastern Kentucky and West Virginia* (FWS/OBS-78/84). All of these publications are available from the Eastern Energy and Land Use Team (EELUT) of the Office of Biological Services, U.S. Fish and Wildlife Service, Route 3, Box 44, Kearneysville, West Virginia 25430. Much additional information can be obtained by consulting references listed in Volume I of this two-volume work or by contacting the agencies or firms listed therein.

The reader should be aware that certain parts of this manual contain information on the "Surface Mining Control and Reclamation Act of 1977" and its Regulations that may be subject to significant revision. A Court Order in August 1980 remanded certain Sections of the Regulations for review by the U.S. Department of the Interior. A ruling concerning the outcome of the review process is expected in late 1981. An Addendum to this manual will be distributed when final revisions to the Regulations are received.

EXECUTIVE SUMMARY*

This two-volume work summarizes, evaluates, and interprets much of the information developed during the past 40 years on coal surface mining reclamation and fish and wildlife relationships in the eastern United States. It provides an overview of the Surface Mining Control and Reclamation Act of 1977 (P.L. 95-87) with particular reference to its implications for fish and wildlife planning and management in the future. It identifies sources of technical and financial assistance and suggests opportunities and approaches that can be helpful in fish and wildlife conservation and management in surface mining and reclamation. Where feasible, a distinction is preserved among: (1) areas to be mined; (2) areas being mined, or very recently mined; and (3) areas which have been mined, sometimes years ago. Throughout the publication a clear theme identifies the need for cooperation among technical specialists working in interacting, though distinct, fields, such as biology, engineering, law, and planning.

Volume I

Past Findings, the Surface Mining Law of 1977 (P.L. 95-87), Planning and Management Considerations, and Information Sources.

This volume, containing references, is composed of three major parts, a references cited section of over 180 entries, a subject matter index, and 11 appendices, in addition to the front end material. It is intended as an information source book for the use, primarily, of fish and wildlife administrators, biologists, and consultants concerned with planning and management for fish and wildlife on surface-mined areas. However, other concerned individuals such as planners, landowners, coal mine operators, government officials, lawyers, and members of professional societies and private conservation groups will be able to use this volume whether or not they have had biological training. For the busy reader, there is a summary at the beginning of each part of the report.

Part 1 provides background information on the extent and nature of surface coal mining areas in the East, briefly discusses land use alternatives for surface-mined areas, describes environmental effects of mining, and presents a comprehensive review of known fish and wildlife responses to habitat alterations caused by mining and reclamation activities in the past. Appraisals are included of the rather limited management efforts made specifically for fish and wildlife enhancement to date.

It is recognized that surface coal mining is essential to meet national coal needs. As of January, 1965, land in the United States disturbed by surface mining for coal totaled over 1.3 million acres, about half of which had been contour mined and half mined by area stripping. As practiced prior to enactment of State and Federal protective laws, contour mining, especially, resulted in slides and severe erosion on the steep outslopes which affected streams and other fish and wildlife habitat components. Highwalls as tall as 100 feet were left in some areas. Recently, with modern equipment, "mountaintop removal" and "head-of-hollow fills" have become acceptable means of coal extraction and waste disposal in parts of Appalachia. Where area stripping was practiced, as in parts of Illinois, drainage was mostly internal and the land form left was composed of spoil ridges and valleys, the latter often containing impoundments.

Though less than one percent of the total eastern land area has been subjected to surface mining, environmental impacts have been apparent locally in terms of: visual effects; the torn-up and denuded landscape accompanying mining; air pollution, including dust, noise and air blast; removal of vegetation; change in land surface and drainge patterns; soil erosion and sedimentation; and water pollution. Much of the land was not reclaimed except through natural processes. As of July 1, 1977, the U.S. Soil Conservation Service estimated that about 1.7 million acres of land disturbed by coal mining in the United States needed reclamation. Of this acreage, approximately 82 percent was located in the 10 States of major concern in this report—Alabama, Illinois, Indiana, Kentucky, Maryland, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia.

An analysis of factors which may limit the land use of surface mined areas (Table 3) suggests that there are fewer limitations for fish and wildlife habitat than for woodland/forestry, agriculture, pasture, recreation, residential, or industrial uses. This means that costs of reclamation for fish and wildlife may be considerably less than for other uses. Also, land reclaimed for other purposes may provide fish and wildlife habitat concurrently.

*See Preface note

Environmental effects of surface mining on fish and wildlife habitat are described and responses of fish and wildlife to changed habitat conditions are documented by regions on the basis of numerous published reports. From the information provided, fish and wildlife biologists can gain predictive insight as to what is likely to happen with fish and wildlife populations when an area is mined and reclaimed in certain ways. Though removing vegetation, overburden, and coal from a site eliminates wildlife temporarily and blasting may interfere with the nesting of nearby ground-nesting birds during mining, wildlife repopulates the area as it is revegetated through natural plant invasion and succession or through plantings made by man. Acid mine drainage and fine particle sediments stemming from mined areas may eliminate or result in changes in the populations of aquatic organisms of affected streams and other water bodies for years after mining.

On the other hand, surface mining often has resulted in changes in land forms such as the creation of cliff-like habitat in the form of highwalls, or impoundments, which add habitat diversity. The ridges and valleys left by area strip mining in flat Illinois prairie lands, when covered with woody vegetation, and the creation of new grassland habitat in forested areas of Appalachia by reclamation after mountaintop removal are other examples of increased habitat diversity favorable to certain kinds of wildlife.

Without management, many old, abandoned mined areas have become productive of fish and wildlife as the disturbed surfaces became revegetated and the impoundments less acidic. Enough fish and wildlife work has been done on surface mined areas, however, to show that there can be increased production through management. Thus, through cover management and installation of food plots, populations of bobwhite on mined areas in southern Illinois were increased to levels two and one-half times those on surrounding agricultural areas. On a West Virginia mined site the planting of autumn olive provided food for ruffed grouse and controlled burning increased the availability of insects for bobwhite chicks. Liming and fertilizing have increased fish production in strip mine ponds as has stocking of ponds with fish on a scientific basis.

Part 2 of Volume I deals with P.L. 95-87 as related to fish and wildlife planning and management. Major features of the law are described including provisions for funding and for the environmental standards required for surface mining and reclamation. Enactment of this law is viewed as the beginning of a new era of surface mining and control in which there are new opportunities and challenges for fish and wildlife planning and management. Essentially all of the standards for environmental protection set forth are relevant to fish and wildlife. The report emphasizes that the extent to which fish and wildlife resources are protected and enhanced through implementation of the law will depend, in large part, upon the participation of fish and wildlife biologists and the interested public in the preparation of mining permits and state reclamation plans.

Reference is made to the best technology currently available required for minimizing disturbances and adverse impacts of mining and reclamation activities on fish and wildlife. Possible ways of minimizing such disturbances and of enhancing fish and wildlife are mentioned. These include designation of certain tracts, e.g., unique or fragile biological communities providing critical habitat for threatened or endangered species, as unsuitable for mining, and creating or retaining for fish and wildlife purposes, impoundments in the reclamation of mined areas. Precautions to preserve water quality and protect surrounding lands are emphasized.

The roles and responsibilities of the Office of Surface Mining Reclamation and Enforcement in the U.S. Department of the Interior, the Soil Conservation Service in the U.S. Department of Agriculture, the states, the coal mine operators and landowners, and the public in administering and implementing the program authorized by P.L. 95-87 are outlined. In addition, technical and financial assistance available from other federal and state agencies, universities, private industry, scientific societies and conservation organizations is discussed. In this discussion many pertinent references are provided and the names and addresses of key contacts are listed in appendices to the report. Likewise, many other federal environmental laws and Executive Orders relevant to surface mining and fish and wildlife conservation are identified.

Part 3 of Volume I focuses on approaches to, and sources of information for, planning and management of fish and wildlife on surface-mined areas. The information presented, including many references to publications providing details on various methodologies, should be valuable both for preparing mining permit-reclamation plans and for managing fish and wildlife resources. Topics treated include: (1) desirability of participation by biologists in collecting data and formulating reclamation plans; (2) early formation of a continuing relationship of biologists with other professionals; (3) concern of landowners and coal operators with postmining land uses; and (4) viability of reclamation for fish and wildlife as an alternative use of the land.

For non-biologists, fish and wildlife requirements—food, water, cover, and a place to live—and wildlife management approaches—habitat management, regulations protecting resources and governing harvests, predator control, stocking, and so forth—are described in relation to surface-mined areas.

The main emphasis in Part 3, however, is on needs and sources of information for planning and management. Addressed specifically in this connection are: (1) fish and wildlife inventories; (2) analyses and handling of soil, overburden, and spoil; (3) soil erosion control; (4) pollution control; (5) water data and water management; (6)

land use data; (7) vegetation and its management; (8) preferences of people and socioeconomic impacts of mining and reclamation; and (9) fish and wildlife management. A sketch is provided at the end of Part 3 illustrating management measures that can be applied on surface-mined areas for fish and wildlife enhancement.

Volume II

Opportunities and Approaches for Fish and Wildlife Planning and Management in Coal Surface Mining Reclamation and Postmining Land Use.

This volume is intended, primarily, for the use of technicians, consultants, planners, landowners, and coal mine operators in preparing mining permit-reclamation plans and in managing fish and wildlife on surface-mined lands. Though numerous publications are mentioned within the text, no separate references cited section is included in this volume. Readers desiring more detailed information on some of the topics mentioned, e.g., acid mine pollution and handling of spoil materials, may wish to refer to Volume I or to references cited in that document.

Volume II contains five parts and five appendices. The first appendix is a work sheet used in determining priority and main benefits of projects conducted under the Rural Abandoned Mines Program (RAMP) administered by the Soil Conservation Service. The other four appendices include lists and characteristics of plants recommended for habitat development on surface mined lands, sources of planting stock and seed of the recommended plants, suppliers of planting stock and seed, and lists of contacts for state assistance in obtaining fish for stocking of impoundments. The volume identifies opportunities for fish and wildlife planning and management in connection with different methods of surface mining and reclamation. It is illustrated to show technicians, landowners, and others what wildlife areas look like at different stages of development.

The introduction to Volume II points out that environmental impacts of surface mining in the past have led to the enactment of many state and federal laws to govern mining and require reclamation of surface mined lands. Many old, abandoned mine sites have become productive of fish and wildlife without deliberate management for fish and wildlife; however, in the relatively few areas managed scientifically for fish and wildlife, results have been encouraging. Management has included wildlife food and cover plantings and in the case of ponds in surface mined areas—maintaining suitable pH levels, fertilizing, stocking, and regulating numbers and species of fish in the pond fish populations. With the ever increasing intensity and scale of agricultural operations and various types of development, lands surface-mined for coal are becoming increasingly important as habitat, or potential habitat, for fish and wildlife. As indicated previously, some of these areas already produce fish and wildlife; others can be made more productive. Some areas can be reclaimed for the primary purpose of providing fish and wildlife in such a way as to meet the requirements of P.L. 95-87 at less cost than reclamation for other purposes. Other areas reclaimed for agriculture, forestry, or other purposes can be managed, both to achieve the primary postmining land use, and to enhance fish and wildlife. Such enhancement can be accomplished by including provisions in the mining permit-reclamation plans and management programs to satisfy the requirements of fish and wildlife, i.e., food, cover, water, and living space.

Part I briefly reviews fish and wildlife-surface mining relationships and points out that although many wildlife species, like agricultural crops, tend to fare better on fertile soils than on infertile soils, wildlife habitat can include large boulders and steep, rocky slopes not suitable for row crop agriculture or for many other uses. Few forms of wildlife are to be found on barren areas recently surface mined and unreclaimed, but when the areas are revegetated or have vegetation close by, some wildlife almost certainly will use the areas regardless of the postmining use. The kinds of animals—particularly mammals, birds, fish, amphibians, and reptiles—commonly found on abandoned or reclaimed surface mine sites are identified. The importance of "edges" to wildlife is explained and the desirability of including areas adjacent to the mined site in planning and management is emphasized because the living requirements of many species cannot be met on the mined site alone. Most wildlife species invade surface-mined sites from adjacent areas, but fish usually are introduced by man into isolated ponds where they can survive only if conditions are favorable.

This publication focuses on the eastern United States, rather than being nation-wide, but there are regional differences within the area as reflected in the pH of strip mine ponds, in topography, in soils, in vegetation and so forth. These differences must be considered in planning and management. Biologists and planners must be alert, also, to the stricter regulation of surface mining and reclamation imposed by P.L. 95-87 and to the possibility of variances from some of the requirements to benefit fish and wildlife if fish and wildlife is a preferred postmining land use.

Part 2 deals with special considerations for fish and wildlife in applying for surface mining permits and in reclamation planning under P.L. 95-87. Important additional references are given in this connection. Much of this part of the publication is devoted to checklists of suggested steps for use of landowners, coal mine operators, biologists, technicians, and planners concerned with fish and wildlife planning and management as related to surface mining, reclamation, and postmining use of lands surface-mined for coal. The steps suggested, based in part on requirements of the Act, apply to different situations including: (1) all lands in which fish and wildlife values are considered in planning; (2) areas to be mined; (3) those areas being mined, or mined only recently; and (4) areas mined long ago and abandoned.

These steps are intended to assure that attention is given to provisions of P.L. 95-87 for environmental protection and to promote fish and wildlife enhancement, whether fish and wildlife habitat is the major postmining use or a secondary use. A checklist is provided for each of the situations or categories mentioned above and, where pertinent, attention is called in the later checklists to suggestions made previously.

The suggestions deal with such items as collecting, organizing, and analyzing the data needed for planning; mapping; determining the presence of endangered or threatened species and unique biological communities on areas prior to mining; taking steps to preserve such species or communities; preserving undisturbed, as much as possible, the original vegetation on an area; choosing land-use alternatives and harmonizing fish and wildlife values with the postmining land use selected; routing and construction of roads; creating of impoundments; planning for revegetation to benefit wildlife handling of topsoil and spoil; identifying sources of pollution; and considering ways of diversifying the habitat, e.g., planting shrubs in old fields or areas with primarily herbaceous cover, and developing travel lanes and woods or field borders.

Part 3 focuses on the management of particular habitat components for fish and wildlife in relation to surface mining and reclamation. It suggests ways of benefiting fish and wildlife in conjunction with the erosion and pollution control, soil and water management, and revegetation of mined areas required by P.L. 95-87.

Management of mine soil and spoil is reviewed briefly and the reader is referred to Volume I for more details. It is pointed out that some variation from the original landform can be beneficial for fish and wildlife and that a good case can be made for creation of permanent impoundments or perhaps exceptions to other requirements of the Act. There is a possibility of saving time and money if impoundments having the desired proportions can be created when excavating the coal and regrading the spoil surface. Quick revegetation limits soil erosion, sedimentation, and often acid mine water pollution.

In connection with water management, every effort should be made to protect existing waters from acid mine drainage and sedimentation. Use of buffer strips of vegetation is described and the value of overhanging vegetation in shading the water and providing insect habitat is discussed. Permanent impoundments provide both habitat for fish and constant water for terrestrial wildlife, and may produce recreational fishing or marketable fish. Information is provided on characteristics of ponds for fish and for other wildlife and a reference dealing with pond construction is cited. The condition of streams and ponds on or near surface-mined sites should be determined so productive ones can be maintained, while nonproductive ones can be improved. New impoundments should be designed according to their proposed use. Water level control devices, especially on larger impoundments, permit accommodating needs of both fish and wildlife. Deliberate formation of islands in new surface mine lakes increases edge and otherwise improves wildlife habitat. Existing ponds may be improved and suggestions are given on how to do this. For fish production in streams it is important that erosion, sedimentation, and acid mine drainage be controlled. Stream channelization is prohibited by P.L. 95-87. Suggestions are made for rehabilitating streams channelized in previous mining. Advice on stream habitat improvement is available from USFS, Fish and Wildlife Service, SCS or state biologists.

Vegetation management is the primary means of managing wildlife. Revegetating a mined area requires considering soil, water, and other environmental factors, as well as the proposed postmining land use of the area. The primary focus in this section is on management of vegetation in a manner that benefits wildlife in addition to its erosion and pollution control, timber and crop production, and aesthetic values. The value of vegetation for wildlife can be increased by edges and diversity of plant species and vegetative growth forms. In general, large plots of uniform plant growth do not favor wildlife. This is why openings in large forested areas are desirable. Diversity of cover can be attained by plantings and by other means which are described. Appendix B of Volume II lists plants valuable to wildlife and recommended for wildlife habitat development on surface-mined land. Suppliers of planting stock and seed are listed in Appendix C.

The process of plant succession is described and methods of establishing and maintaining successional stages desired for certain types of wildlife are presented. Cutting, controlled burning and grazing, disking, selective use of herbicides, and water level manipulation are tools that can be used in vegetation control. Control of water levels is apt to be more successful than planting in establishing aquatic plants.

One part of this section deals with vegetation management for selected areas or purposes. Treated are: (1) streamside vegetation in relation both to fish and wildlife and erosion control; (2) roadside plantings; (3) wildlife travel lanes; and (4) field and woods borders. Suggestions on ways of establishing and managing vegetation in these categories are provided, along with recommended plant species.

Part 4 deals primarily with fish and wildlife management measures not directly related to soil, water, and living vegetation. It is pointed out that except in the case of cold-water ponds where the owner wishes to provide fishing through frequent stocking and rearing of trout to catchable size, in which feeding of commercially available pellets is necessary, most artificial feeding for wildlife on surface-mined areas is unjustified. Feeding can, however, attract wildlife to areas used for recreation and wildlife viewing. Similarly, predator control probably cannot be justified except under special situations, such as benefiting a preferred species. The best predator control is establishing and maintaining effective nesting and escape cover. Because of their difficult terrain, strip mined areas may serve as wildlife refuges whether or not they are so designated, but their management as refuges may preserve valuable habitat.

More applicable to surface-mined areas are regulations governing the taking of fish and wildlife; the installation of nesting, resting, and cover devices which are described in some detail; stocking of newly reclaimed lands, particularly of fish, fencing of ponds to prevent damage by livestock; liming and fertilizing of ponds to improve water quality; fish population control; and providing cover and spawning beds for fish. Another integral part of planning and management which is discussed, is the evaluation of management measures, to determine their effectiveness and to provide a basis for any updating or revisions necessary in the management plan.

Part 5 provides illustrated examples of fish and wildlife management measures suggested earlier in the text which can be applied on different types of surface-mined areas in the eastern United States. Each example is illustrated by three sketches depicting the area before mining, during mining, and following mining and reclamation. The first example, based in part upon an aerial photograph taken by the senior author southeast of St. Louis, shows how an area in flat, fertile terrain which has been strip-mined can be improved for fish and wildlife and recreational use. The second example depicts a situation which might be found in East Kentucky and Tennessee or elsewhere in Appalachia in which a forested area has been mined by the contour method. The third example illustrates the type of habitat alteration and fish and wildlife management practices that might be applied to an area involving mountaintop removal and head-of-hollow fill. Legends accompanying each example explain the management measures taken to enhance fish and wildlife. Readers are advised to refer to the explanations previously provided regarding travel lanes, field border plantings and so forth.

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Acknowledgements

Much of the background information used in preparing Volume II was assembled and documented in developing Volume I of this manual. In the present volume the information has been sifted, summarized, and presented in semipopular form with few references. The personal knowledge of the authors has been complemented and supplemented by visits to surface mining sites and discussions with coal mine operators, federal, state, and university personnel, and others concerned with coal surface mining and reclamation. We especially wish to express appreciation to: Robert W. Holloway, Manager, Land Resources, Southwestern Illinois Coal Corporation, Percy, Illinois; Dale Fowler, Biologist, Tennessee Valley Authority, Norris, Tennessee; Willie Curtis, U.S. Forest Service, Berea, Kentucky; and Willard D. Klimstra and his associates at the Cooperative Wildlife Research Laboratory, Southern Illinois University at Carbondale.

Thanks are due William T. Mason, Jr., and Charles T. Cushwa, Project Officers for the Eastern Energy and Land Use Team (EELUT), Fish and Wildlife Service, Kearneysville, West Virginia and to other members of this Team who offered advice and encouragement. In addition, use of some information on water and fish management was extracted from a preliminary report submitted to EELUT by Charles A. Whitehurst and Robert L. Downing based upon a study conducted in cooperation with the Aerospace Corporation, El Segundo, California. Robert W. Hines, artist in the Fish and Wildlife Service's Washington, D.C. headquarters, prepared sketches to illustrate habitat management for fish and wildlife in reclaiming different types of surface mine areas.

Our thanks are also expressed to Louise Dove and Joyce Keifer of the Urban Wildlife Research Center, Inc., for assistance in preparing the appendices to this volume.

Aerial photo of reforested strip mine banks in southwestern Indiana. ***Indiana Coal Producers Assn.***

Introduction

As of 1965, the U.S. Department of the Interior concluded that probably only one-third of the total 1.3 million acres of lands disturbed by surface mining had been adequately reclaimed by natural forces or by man's efforts. As of July 1, 1977, the Soil Conservation Service indicated that of 1,667,168 acres of coal mined land requiring reclamation, 1,336,083 acres or 82 percent were in the States of Alabama, Illinois, Indiana, Kentucky, Maryland, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. For the entire country, some 3.7 million acres of land were used for mining, including non-coal minerals such as sand and gravel during the period 1930-71. Over 2 million acres have been disturbed by surface mining in the East alone. Most of this land is owned by the mining industry and by farmers.

Although only a small fraction of the total land area in the United States, the land used for surface mining of coal is of great importance. Not only is the coal produced vital to the country for energy, but the postmining use of the land is important. With the present and predicted energy shortages much more land will be mined for coal in the future.

Surface-mined lands need not be wastelands. They can be reclaimed for many purposes—agricultural, forestry, parkland, industrial, residential, pastureland, recreational, fish and wildlife habitat, or a combination of these uses. The scars left by surface mining and the other environmental impacts of mining activities have resulted in the enactment of many state and federal laws to govern mining and require reclamation of surface-mined lands. The Surface Mining Control and Reclamation Act of 1977 (P.L. 95-87) includes new requirements and has resulted in the enactment of new state laws or revision of existing state laws. These requirements will not be treated in detail here. The law does provide, however, that mined lands may be reclaimed for fish and wildlife as well as for other purposes. Our emphasis will be on opportunities for fish and wildlife enhancement, whether on lands reclaimed primarily for that purpose, or in connection with other postmining land uses.

In the past, many areas surface-mined for coal have become valuable habitats for fish and wildlife with little specific fish and wildlife management. In some cases, the results of mined land vegetative succession resemble the general natural habitat from lowland wetlands to woodlands at higher elevations. Good fish and wildlife habitat on former mined lands is a result of natural plant invasion and succession on mined areas and invasion of animals from adjacent areas. Impoundments created by surface mining, although often too acid for good fish production, improved with time and with the revegetation of the spoils. Some of these were stocked by landowners or enterprising fishermen and sustained populations of fish. Usually, however, such stocking was on a hit or miss basis with little attention given initially to species selection or composition and with little regulation of the ratios between pan fish, such as bluegills, and predators, such as black bass.

In the relatively few areas managed scientifically for fish and wildlife, results have been encouraging. Management has included wildlife food and cover plantings and—in the case of ponds in surface-mined areas—maintaining suitable pH levels, fertilizing, stocking, and regulating numbers and species of fish in the pond fish populations.

Approaches to fish and wildlife management suggested in this publication are based on knowledge gained from past studies and management. On areas reclaimed to resemble premining conditions in topography, drainage, and vegetative cover, management techniques proven effective in nonmined agricultural or forest areas may be appropriate. With areas recently mined, and, especially, areas to be surface-mined, there are opportunities to "start from scratch" with revegetating recently disturbed areas or to plan for the best utilization of the areas for fish and wildlife.

With the ever increasing intensity and scale of agricultural operations and various types of development, lands surfaced-mined for coal are becoming increasingly important as habitat for fish and wildlife. Some such areas already contain good fish and wildlife while others can be made more productive. Some areas can be reclaimed for the primary purpose of providing fish and wildlife in such a way as to meet the requirements of P.L. 95-87 at less cost than reclamation for other purposes. It is also possible that areas reclaimed for fish and wildlife habitat can be leased to hunting and fishing clubs for a fee. Other areas reclaimed for agriculture, forestry, or other purposes can be managed both to achieve the primary postmining land use and to enhance fish and wildlife. Such enhancement can be achieved by including provisions in the mining permit reclamation plans and management programs to satisfy the requirements of fish and wildlife, i.e., food, cover, water and living space necessary for their sustenance, protection, reproduction, and survival in the face of competing land uses or environmental limitations.

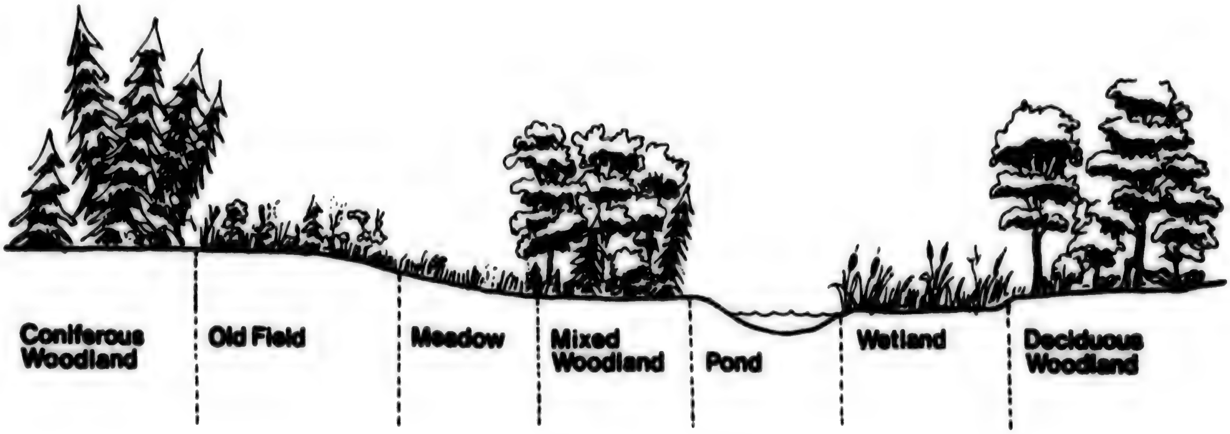

Figure 1. Habitat types. (Figure from "Planning for Wildlife in Cities and Suburbs.")

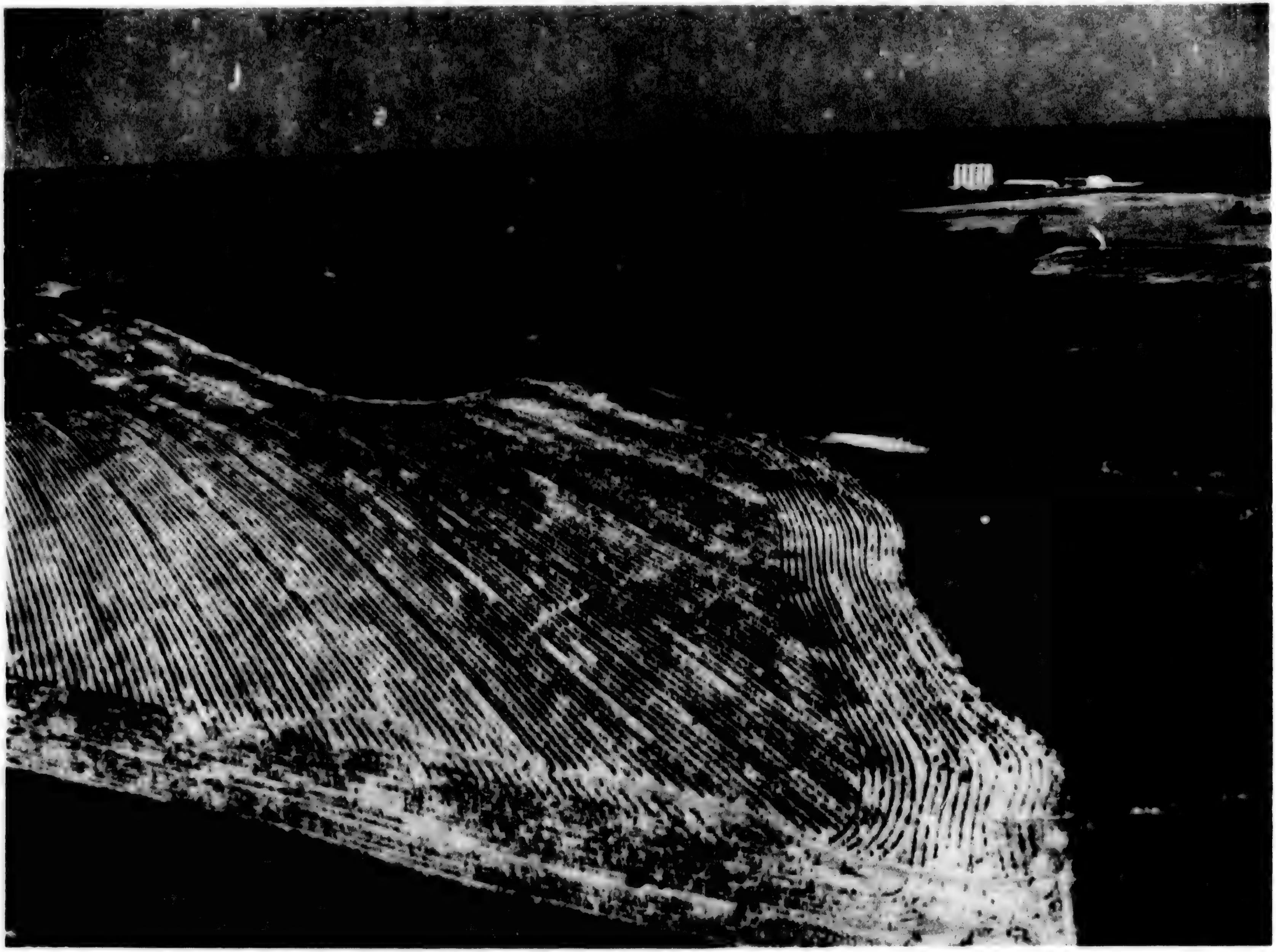

Figure 2. Corn, as well as forage, can grow on former coal land. Ponds in the background—former pits—provide watering places for cattle and wildlife. (Photo, National Coal Association)

Fish and Wildlife and Environmental Considerations.

PART 1

Fish and Wildlife and Environmental Considerations

General

Fish and wildlife resources are viewed broadly in this handbook, to include not only finfish and wild mammals, birds, reptiles and amphibians, but also mollusks, crustaceans, and other invertebrates. Some of them, for example zooplankton, are microscopic but important in the food chains of the higher vertebrates. But wildlife is dependent upon another vital resource—plants—for food and in many cases for cover or a place to perch, nest, breed and reproduce. Plants, in turn, are dependent upon soil, water, and climatic conditions, including temperature, sunlight, wind, and precipitation; and upon geologic and physiographic conditions.

Fish and Wildlife in Relation to Surface Mining

To survive and reproduce, fish and wildlife must have food, water, cover, and living space. Generally, surface mining, while in progress, eliminates most of the fish and wildlife from the site and the area immediately after mining provides poor habitat. Before mining, the vegetative cover is removed and before or during the course of mining, haul roads and other facilities are constructed. There is pollution from dust, noise, and other disturbances. The mined area is left barren of vegetation and subject to erosion. Unless care is taken, streams will be degraded as habitat for fish and other aquatic organisms.

In the past, especially in areas where contour mining was practiced, spoil pushed downslope from the mines was subjected to accelerated erosion; vegetation was buried; and slumping or landslides blocked streams. Highwalls and steep banks along impoundments created by surface mining tended to prevent circulation and aeration of impounded water by wind. Many of the impoundments were not readily accessible for fishermen or fish management. Also, the surface-mined areas and the impoundments mining created generally were infertile, low in pH, and lacking in organic matter.

Despite these unfavorable conditions, fish—whether stocked officially by state agencies, or by fishermen—and wildlife—usually invading from surrounding areas—repopulated most surface-mined areas in time, the land only when the areas were revegetated. Even the highwalls were used by birds such as phoebes and swallows.

Despite the resiliency of fish and wildlife species and their ability to occupy unfavorable sites, they, like agricultural crops, tend to fare better on fertile soils providing nutrients and their other needs. Yet wildlife habitat can include large boulders and steep, rocky slopes not suitable for row crop agriculture or for many other purposes. Thus reclamation meeting the requirements of P.L. 96–87 may be accomplished less expensively for fish and wildlife habitat on many sites than for other postmining land uses. However, regardless of the postmining use made of a mined area, if it is vegetated or has vegetation close by, wildlife of some kind will use it, even if the site is devoted to residential development. Furthermore, there are opportunities to enhance wildlife on almost any site.

The presence or absence, and the kinds of wildlife found on surface-mined areas will depend largely on habitat conditions and the extent to which wildlife needs for food, cover, water, and space for breeding, rearing young, and living are met. With fishes, their presence in an isolated surface mine pond generally depends, initially, upon their release by man. But for their continued survival and reproduction, they must have water of adequate quantity and quality, food, and cover. Many surface-mined areas are too small to satisfy all the requirements of certain species. Therefore the type of adjacent habitat is important in planning and management. For example, foxes may den on a surface-mined area, but range off the area for some of their feeding.

Few forms of wildlife are to be found on barren areas recently surface-mined and unreclaimed. Past studies have shown, however, that with revegetation, either through natural invasion and succession of plants or through seeding of grass and legumes or planting of trees and shrubs by man, surface-mined areas may have more wildlife than surrounding agricultural or forest areas. Surface-mined sites, depending on how they are reclaimed, tend to complement the habitat components of the areas in which they are located, adding diversity of vegetation and land form—including development of new bodies of water—and increasing the amount of "edges" so valuable to wildlife. Areas at the edges of the two types of vegetative cover or adjacent to streams and lakes or ponds are known to be especially important to wildlife. Thus an opening created by surface mining in an

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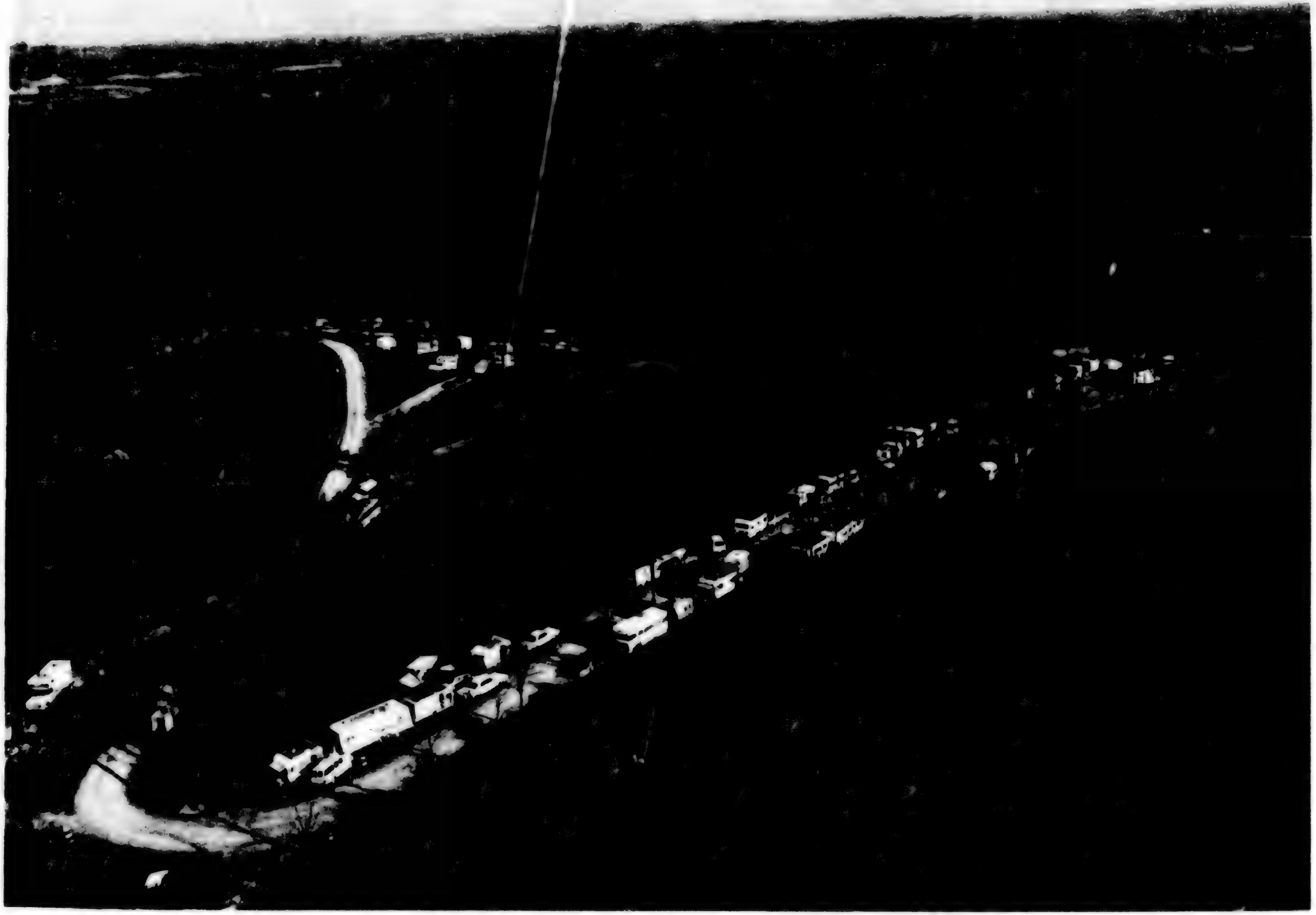


Figure 3. Trailers, camper trucks and tents line the roadside as the Ohio chapter of the National Campers and Hikers Association holds a three-day conservation workshop at campgrounds on reclaimed strip mine land. By 1969, the coal company had mined and reclaimed more than 20,000 acres, creating hundreds of ponds and planting more than 24 million trees. At campsites the company supplies water, firewood, shelters, restrooms and picnic tables. (Photo, National Coal Association)

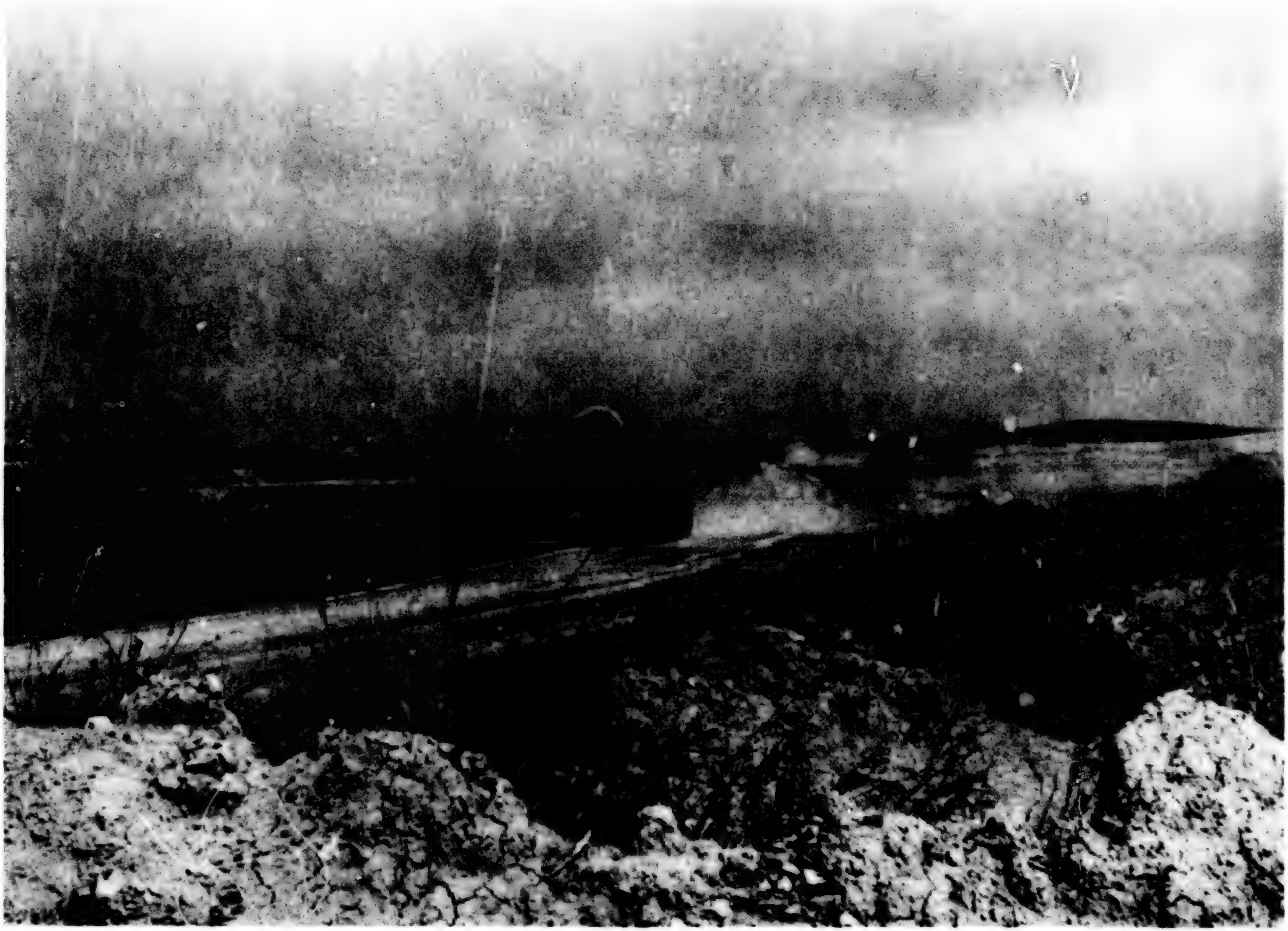
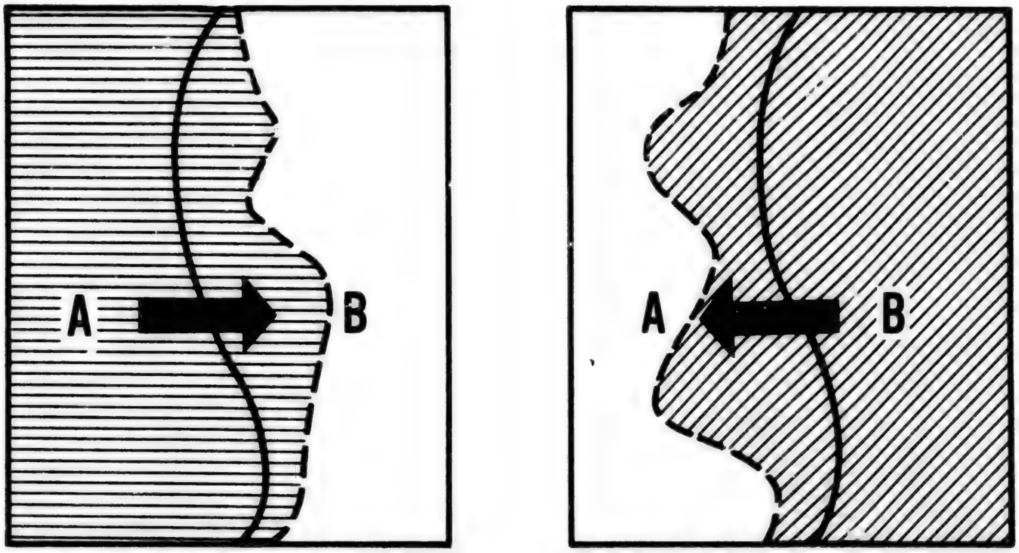


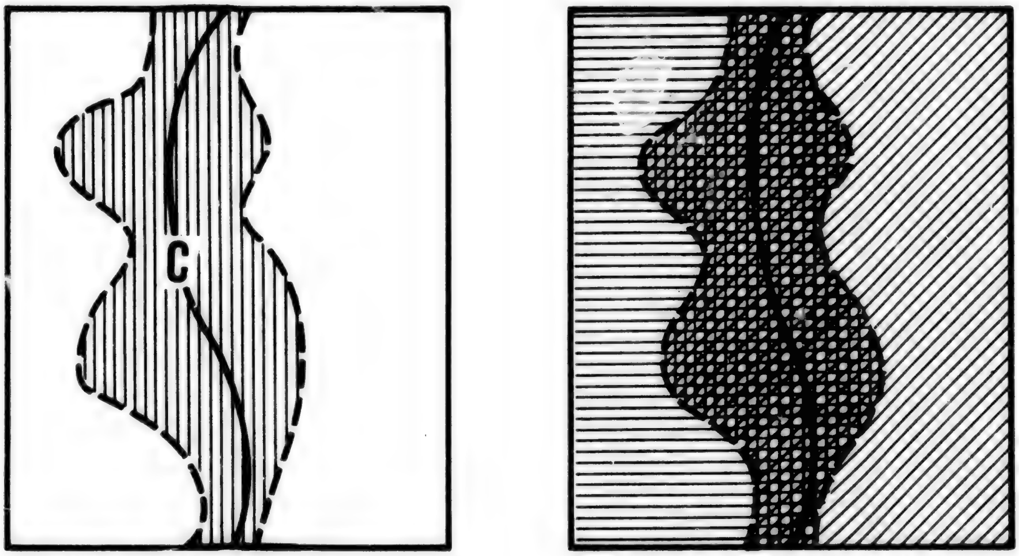
Figure 4. Hauling coal in Illinois. Pollution can be caused by dust, noise, and other disturbances. Mined areas are subject to erosion if left barren of vegetation. (Photo, D. L. Leedy.)

Figure 5. Red fox on surface-mined area. (Photo, U.S. Forest Service)



SOME WILDLIFE FROM HABITAT A OVERLAPS INTO HABITAT B

SOME WILDLIFE FROM HABITAT B OVERLAPS INTO HABITAT A



SOME WILDLIFE IS PARTICULARLY ADAPTED TO EDGE C

EDGES ARE RICH IN WILDLIFE SPECIES

Figure 6.

Appalachian forested area and used after mining for agricultural crops, or seeded to grass and legumes to prevent erosion, provides edges and a new habitat for wildlife. Likewise, revegetation with trees and shrubs of a ridge-and-valley type of strip-mined area in flat Illinois prairie land, now devoted to the production of corn or other agricultural crops, creates diversity conducive to wildlife use.

Among the mammals commonly invading surface mined sites are deer mice, white-footed mice, cottontail rabbits, field mice or voles, shrews, and moles. Many of these small mammals, which feed on vegetation and on insects and other invertebrates, serve in turn as food for foxes and birds of prey. Other mammals using surface-mined areas include woodchucks, opossums, raccoons, foxes, deer, and bats. Muskrats, mink, and beaver may be found in areas with streams or impoundments. Except for occasional forays, use of surface-mined areas by tree squirrels is restricted largely to areas mined long ago and having trees large enough to produce mast and contain cavities for dens.

Essentially all components of surface-mined area habitat, from water to spoil bank or reclaimed surface, to highway and isolated mountain top, are used by birds. Some of this use is seasonal, as in the case of migratory birds; some of it is year-long. Long lists of birds found on surface-mined areas have been compiled, including many song birds, and various species of waterfowl, herons, and shorebirds in addition to hawks, owls, and game birds such as the ruffed grouse, bobwhite quail, and mourning dove. In the newly created grasslands of northern West Virginia, a relatively few species such as the horned lark, eastern meadowlark, red-winged blackbird, and various sparrows are now found in place of the 40–50 species of breeding birds that used the woodland prior to mining and reclamation, and still use the surrounding forested areas.

A majority of the species of amphibians and reptiles occupying areas adjacent to surface-mined areas have been able to invade the new environment, particularly in or adjacent to impoundments with shallow water and aquatic vegetation, rather than in the deeper impoundments with steep banks and a scarcity of shallows and vegetation.

Fish found in strip mine lakes include green sunfish, bluegills, bullheads, largemouth bass, white crappie, redbreast sunfish, and redear sunfish. Various kinds of trout, channel catfish, and chain pickerel have been stocked with varying success. In streams severely degraded by acid mine water pollution and fine-particle sedimentation, the numbers of species of fish and invertebrates are reduced for as long as 10 to 20 years after mining. A study of a stream in Tennessee, for example, revealed that the creek chub, a top-water feeder, comprised most of the total fish population. However, with the control of pollution and sedimentation, the aquatic fauna of streams can be restored, especially where there are unpolluted tributaries that serve as reservoirs of species to restock the recovered stream.

Regional Differences

This document focuses on surface mining in the coal basins of the eastern United States rather than dealing with the reclamation of mined areas nationwide. But there are marked regional differences in conditions within the area of concern. Partly in recognition of these differences, the regional offices of Federal resources agencies tend to be in the same major cities or in the same general areas. In the case of the U.S. Fish and Wildlife Service, states dealt with in this handbook are in three of the Service's regions. Illinois, Indiana and Ohio are in Region 3 with the regional office in Minneapolis. The Northeast region (headquarters in Newton Corner, MA) contains the coal-producing states of Pennsylvania, Maryland and West Virginia. Kentucky, Tennessee, Virginia, and Alabama are in the Southeast Region, with headquarters in Atlanta.

In some respects, the coal fields of western Kentucky are more similar to those of southern Illinois and Indiana than to those of the more mountainous country of eastern Kentucky, Virginia and other Appalachian states. The more northerly coal fields of Illinois are in relatively flat country which was once prairie grassland and now is fertile farmland. Coal mining in eastern and southeastern Ohio is in hilly or rolling country formerly covered with largely deciduous forests. Although most of the area was cleared for farming, much of it is now reverting to brush and forest or is used for pasture.

Basically, the differences in these areas can be attributed to differences in geology, topography, climate, soil, and vegetation which, in a natural state, largely reflects the other environmental factors.

Although the coal producing strata were formed during the Pennsylvanian age, the strata above or below the coal vein can differ in composition. In many cases, removal of the topsoil and overburden results in the exposure of acid forming materials. If these materials are not covered, acid mine water results in pollution of receiving bodies of water. In other cases, the overburden may have a neutral or alkaline pH. Fish and wildlife planning and management will vary accordingly. For example, in some of the northern Illinois mined sites, water in strip mine ponds may be neutral or somewhat alkaline; in some of the Appalachian mined sites, the spoil or the water in mined area impoundments is too acid for fish survival and reproduction without the addition of lime.

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Figure 7. Beavers may be found using surface-mined areas with streams in impoundments. These trees have been cut by beavers. (Photo, U.S. Forest Service.)

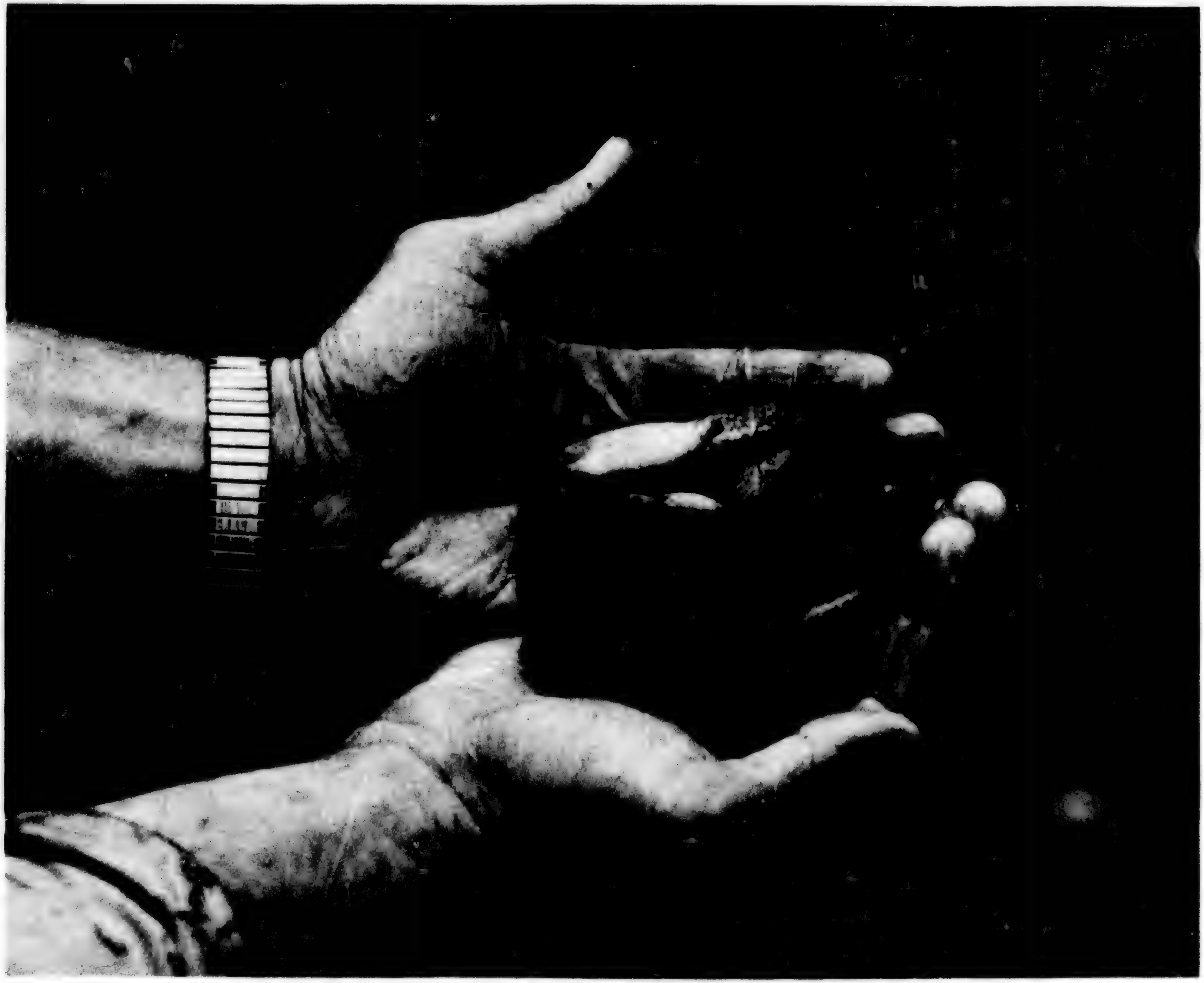

Figure 8. Shallow water impoundments are attractive to amphibians such as these tadpoles. (Photo, National Coal Assoc.)

Figure 9. Shallow pond on surface mine in Eastern Tennessee. (Photo, T. M. Franklin.)

The topography, position and depth of the coal strata, and elevation of the area govern to a large extent the type of mining and reclamation which it is economical to undertake, and, consequently, govern the impacts of mining on the environment. In relatively flat areas where area strip mining is practiced, the mined area becomes a series of parallel ridges or hills and valleys. The valleys often contain ponds. If left ungraded, both the valleys and the ridges provide diversity of habitat. Most of the drainage is internal and causes little sedimentation in adjacent streams. In more hilly, but not mountainous, areas, such as parts of Ohio, modified area stripping is practiced.

Where the relief is more pronounced, as in much of Appalachia, contour mining is common. More recently, because of modern equipment and procedures, it has become possible, in mountainous areas, to remove the entire tops of mountains to extract the available coal and to use the heads of hollows to dispose of the overburden.

The elevation of mined areas is important in that temperature and other climatic factors govern whether or not certain species of plants can be used to revegetate a surface-mined area. Likewise, the nature of the topsoil is important if the soil is separated from the rest of the overburden and used advantageously in reclamation. Generally, the topsoil available in parts of Illinois, Indiana and Ohio is more fertile than in other parts of the coal producing areas in the eastern United States. The length and steepness of slopes in spoil banks help determine whether the spoil can be stabilized by vegetation.

The aspect or direction of the slope can limit the establishment of vegetation. That is, it is usually more difficult to establish vegetation on slopes facing the direction of the prevailing wind than it is on other slopes. Some plants may grow better on steep north-facing slopes than on south-facing slopes apparently because of differences in temperature, sunlight, moisture, wind, and other factors. The same factors, coupled with vegetation differences, affect use of an area by wildlife. Deer, for example, may prefer sunny south-slope openings for resting.

The geographic location has a bearing, also, on use of surface-mined areas by wildlife. For example, migratory waterfowl are more likely to use surface mine lakes within the main flight lines of a flyway than those isolated ponds found in a wooded section of Appalachia outside the major flight lines. In connection with resident wildlife, it is futile to manage for species whose ranges are in an entirely different part of the country and which occur in a different kind of biologic community. This applies to fish and other aquatic life as well as to terrestrial forms.

Implications of P.L. 95-87

Implementation of the Federal Surface Mining Control and Reclamation Act of 1977 will result in stricter regulations for surface mining and fuller reclamation of newly mined areas and many rural abandoned mine sites. From the standpoint of fish and wildlife, the quick revegetation of newly mined sites and the control of erosion, sedimentation, and pollution will be beneficial. Also, the collection of information, some of it biological, needed for preparing the mining permit-reclamation plan required by the Act will be helpful in planning for the protection, enhancement, and management of fish and wildlife. The general nature of the Act, its provisions for environmental protection, and the roles of agencies, landowners-operators and others in administering and implementing the Act are described in Volume I of this two-volume work.

It is appropriate to mention here, however, some possible environmental effects of the Act. With certain exceptions, it is stated in Section 515(b)3 of the Act that it will be required "... with respect to all surface coal mining operations to backfill, compact (where advisable to insure stability or [to] prevent leaching of toxic materials), and grade in order to restore the approximate original contour of the land with all highwalls, spoil piles, and depressions eliminated (unless small depressions are needed in order to retain moisture to assist revegetation or as otherwise authorized pursuant to this Act)." Section 515(b)19 also provides that the coal mining and reclamation operation is to "establish on the regraded areas, and all other lands affected, a diverse, effective, and permanent vegetative cover of the same seasonal variety native to the area of land to be affected and capable of self-regeneration and plant succession at least equal in extent of cover to the natural vegetation of the area; except, that introduced species may be used in the revegetation process where desirable and necessary to achieve the approved postmining land use plan...." Thus, the intent is to restore the land affected to a condition capable of supporting the uses which it was capable of supporting prior to any mining, or higher or better uses.

Obviously, if surface-mined land in a row-crop agricultural area is restored to the same type of row-crop agriculture, and if a forested area is surface-mined and restored to the same type of forest that existed previously, the management recommendations of wildlife biologists will be similar to those for other nonmined agricultural or forested areas. In the case of surface-mined land to be reforested, however, there

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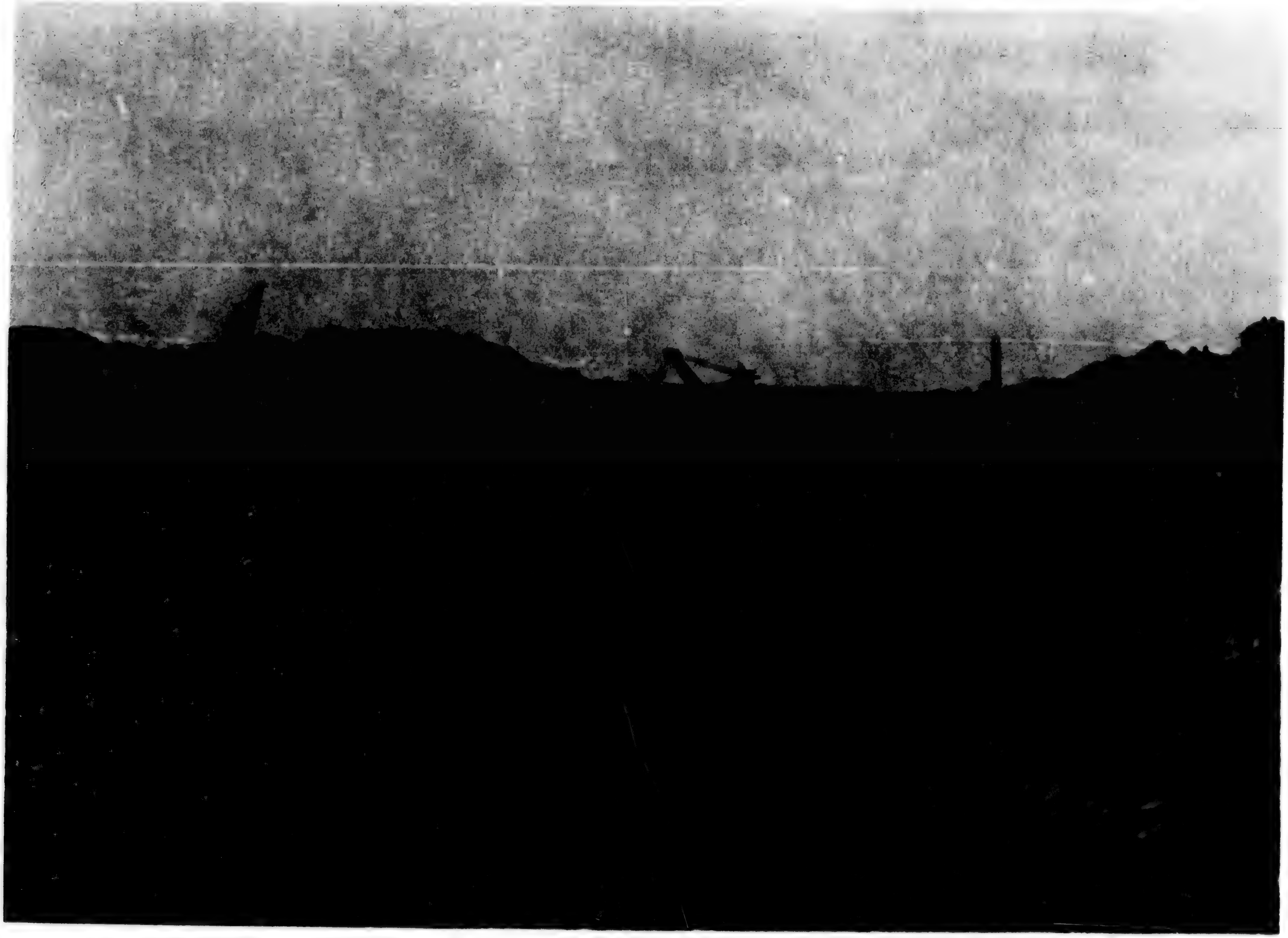

Figure 10. Surface mining in southern Illinois. (Photo, D. L. Leedy.)

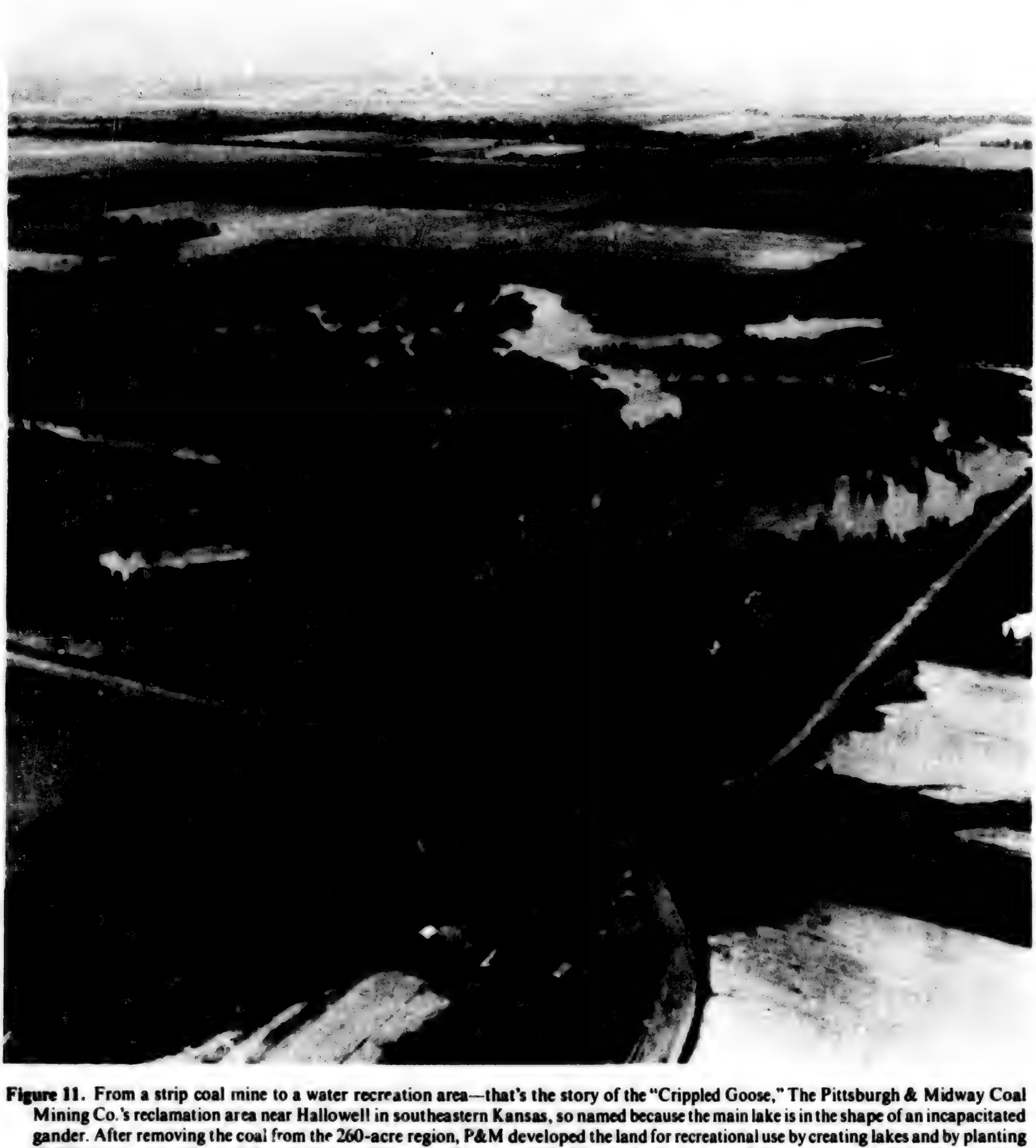

Figure 11. From a strip coal mine to a water recreation area—that's the story of the "Crippled Goose," The Pittsburgh & Midway Coal Mining Co.'s reclamation area near Hallowell in southeastern Kansas, so named because the main lake is in the shape of an incapacitated gander. After removing the coal from the 260-acre region, P&M developed the land for recreational use by creating lakes and by planting 25,000 eastern red cedar and Scotch pine seedlings as well as a growth of Kentucky fescue grass. Ridgetops were leveled and graded for cottage sites and a community park. (Photo, The Pittsburgh & Midway Coal Mining Co.)

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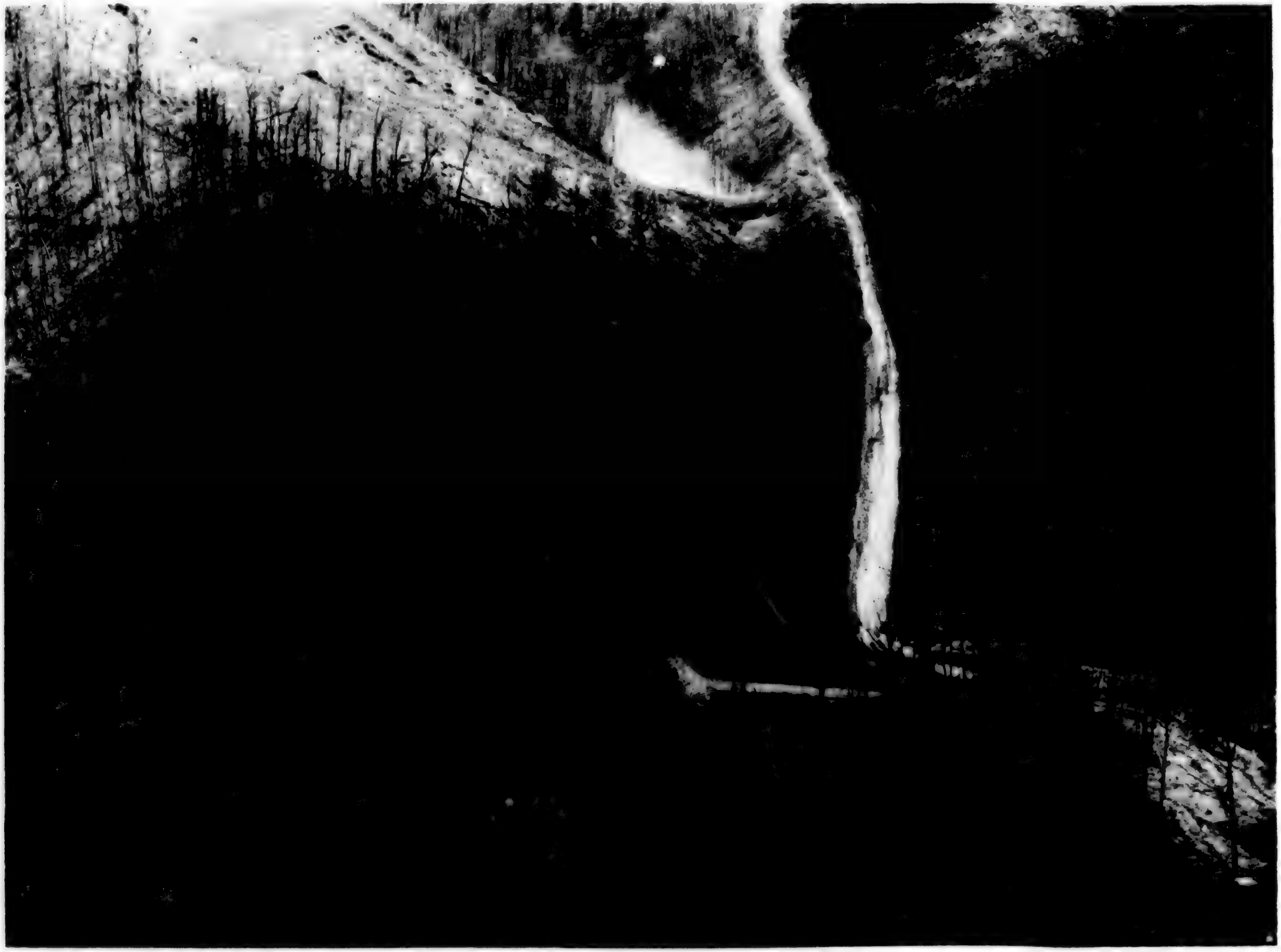

Figure 12. Contour mine in Appalachia. Note water level control structure in pond at left. (Photo, U.S. Forest Service.)

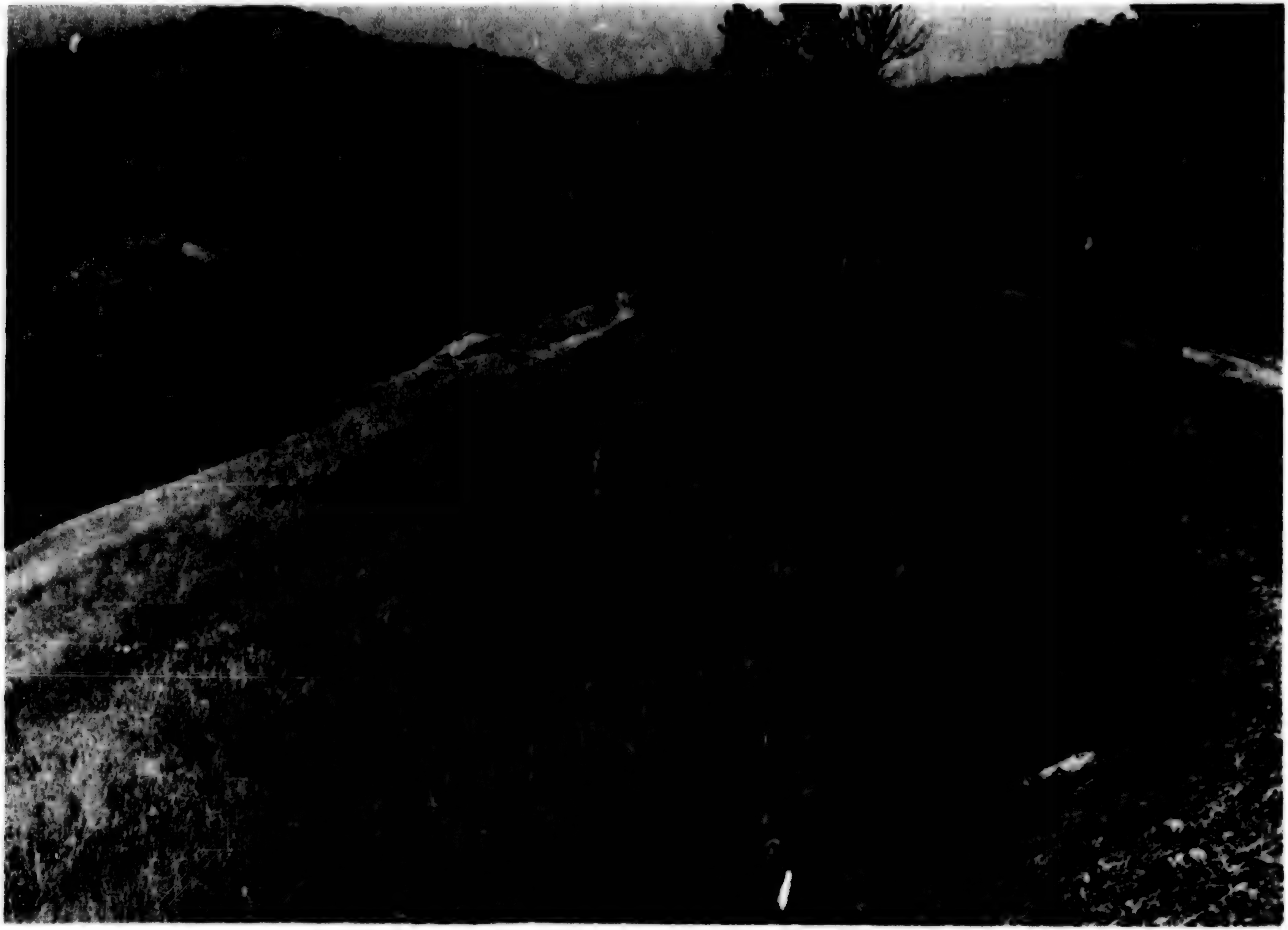

Figure 13. Newly surface-mined area "returned to contour" at demonstration area in eastern Tennessee. (Photo, T.M. Franklin.)

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will be a period of many years during which management can be focused on wildlife communities found in early stages of forest development.

Regrading spoils to attain as nearly as possible the original land contour, and eliminating highwalls and the ridges and valleys (and often lakes) created by area strip mining, will reduce some of the habitat diversity provided by mining. Exceptions to the requirements may be possible for fish and wildlife habitat as a postmining land use. Regardless of the extent of reclamation, biotic and environmental conditions in the various coal regions of the eastern United States will differ and fish and wildlife management recommendations should reflect these differences. The remainder of this document will give attention to opportunities for fish and wildlife planning and management, with respect to both land mined in the past and land to be mined in the future.

Figure 14. Contour-mined area revegetated with wildlife plantings at Tennessee Valley Authority demonstration area. (Photo, T.M. Franklin.)

Surface mine pond in Southern Illinois. (Photo, D.L. Leedy.)

PART 2

Special Considerations for Fish and Wildlife in Applying for Surface Mining Permits and in Reclamation Planning

General

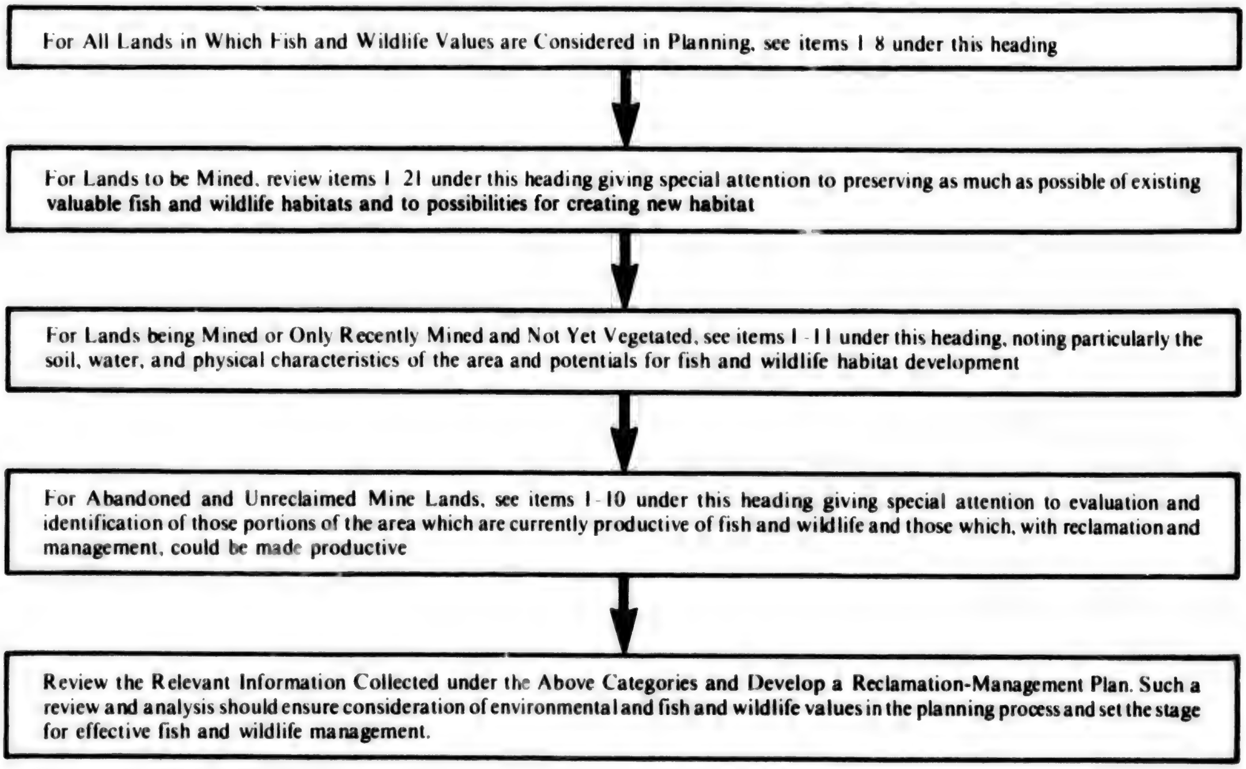
It is recommended that readers who wish more specific information on requirements for applying for a surface coal mining and reclamation permit under P.L. 95-87 refer to: (1) section 507 of the Surface Mining Control and Reclamation Act of 1977; (2) subchapter G, sections 770-795, of the Permanent Regulatory Program authorized by that Act (Federal Register, Volume 44, No. 50, March 13, 1979; (3) *Preparing a Permit—What You Need to Know and Where to Find It,* by P.W. Antonnaria; and (4) Volume I of this two-volume report which also provides references for the above documents.

The worksheet used by the Soil Conservation Service for determining the priority for, and main benefits to be realized from, conservation measures applied in the Rural Abandoned Mine Program (RAMP) authorized by the Act is included as Appendix A to this report.

This section recognizes the requirements of P.L. 95-87 for information to be used in applying for mining permit-reclamation plans, provisions of the Act for environmental protection, and findings related to fish and wildlife on surface-mined areas. It is intended to be a check list of suggested steps for the use of landowners and coal mine operators, biologists, and planners concerned with fish and wildlife planning and management as related to surface mining, reclamation, and post-mining use of lands surface-mined for coal. The steps suggested apply to different situations in: (1) areas to be mined; (2) those being mined, or mined only recently; and (3) those areas mined long ago and abandoned. Some of the items included in the check list are discussed in more detail in succeeding sections.

Figure 15 provides a flow diagram of items to consider in developing mining applications and/or reclamation plans for different lands.

Figure 15—Flow Chart of Planning Suggestions



For All Lands in Which Fish and Wildlife Values are Considered in Planning, see items 1-8 under this heading

For Lands to be Mined, review items 1-21 under this heading giving special attention to preserving as much as possible of existing valuable fish and wildlife habitats and to possibilities for creating new habitat

For Lands being Mined or Only Recently Mined and Not Yet Vegetated, see items 1-11 under this heading, noting particularly the soil, water, and physical characteristics of the area and potentials for fish and wildlife habitat development

For Abandoned and Unreclaimed Mine Lands, see items 1-10 under this heading giving special attention to evaluation and identification of those portions of the area which are currently productive of fish and wildlife and those which, with reclamation and management, could be made productive

Review the Relevant Information Collected under the Above Categories and Develop a Reclamation-Management Plan. Such a review and analysis should ensure consideration of environmental and fish and wildlife values in the planning process and set the stage for effective fish and wildlife management.

FOR ALL LANDS IN WHICH FISH AND WILDLIFE VALUES ARE CONSIDERED IN PLANNING

1. Assemble, organize and analyze the information to be used for planning.

2. Locate on maps or aerial photographs the proposed mine site or the mined site in relation to other mined sites, houses, communities, industries, streams, ponds, and roads.

3. On larger scale maps or aerial photographs dicate the type of vegetative cover, if any, on the mined site and on areas adjoining the site. Areas in cultivated fields and pasture as well as areas in orchards, old fields, or with woody cover should be shown along with drainage channels, wetlands, and ponds.

4. Seek the assistance of biologists in performing a reconnaissance survey of the area and in collecting and analyzing the data, especially with respect to fish and wildlife potentials of the area. (See Volume I for listings of agencies and organizations.)

5. Determine whether there is any likelihood of the presence of threatened or endangered species on the area. If such species might exist on or near the mine site, ensure that careful surveys are made and if such species are found, have them identified and their habitat carefully located on a map. Consult with state and Federal fish and wildlife agencies.

6. Carefully analyze and record the soil and spoil characteristics, topography, aspect, degree of slope and direction of slope, strike and dip of the coal seam, drainage patterns, precipitation, ground water conditions, erodibility of the land, pollution sources, vegetative cover, and land use on and off the site.

7. Choose the land use alternative which best fits the particular combination of site characteristics, adverse impacts, personal interests of the landowner, and local land use plans that may affect the site or be affected by mining the site.

8. Consider all major possibilities for postmining use of the area and if an option other than fish and wildlife habitat is chosen as a primary use of the area, determine how fish and wildlife populations can be enhanced through application of management practices which harmonize with the major selected land use.

FOR LANDS TO BE MINED

1. Be particularly careful in evaluating the presence of any threatened or endangered species. Areas not yet mined are more likely to have such species than mined areas.

2. In defining the site to be mined, try to save undisturbed as much as possible of the mining property, particularly any unique biological communities identified in the premining surveys and in streams, ponds, and vegetation near the perimeter of the area. Such undisturbed sites within the mining property, e.g., a wetland or mature timber along the border of the area, can be invaluable in developing a wildlife habitat management plan for the site after mining.

3. Tracts, even small ones, likely to be left undisturbed in mining, should be carefully located and identified on large scale maps.

4. On timbered sites cleared for mining, arrange to have the limbs trimmed from trees which are sold as timber piled as brush on the perimeter of the property or undisturbed tracts in strategic places as determined by a biologist. Hollow logs or unsalable trees likewise can be pulled or pushed off to one side where they provide good cover for rabbits and other wildlife.

5. Route and construct access or coal haulage roads into the area in a manner that has the least impact on the environment. Thus, the roads should be kept away from streams, if possible, and filter strips of vegetation maintained between roads and streams to reduce erosion and sedimentation. Engineering standards must be met.

6. Avoid using gob for constructing roads because this material may be a source of pollution.

7. Roads ordinarily are to be constructed so as not to interfere with natural drainage. In planning necessary roads, consider opportunities for creating wetlands valuable for fish and wildlife through building highway fills across small natural drainages. Developing such permanent impoundments may be possible under Section 515(b)8 of P.L.95-87. (See Sections 780.25, 784.16 and Part 785 of the Permanent Regulatory Program for stipulations concerning the design, construction and maintenance of permanent impoundments and for permits incorporating variances from approximate original contour requirements for steep slope mining.)

8. Incorporate provisions in the mining and reclamation permit and plan application for creation of permanent impoundments as authorized by the Act. In this connection, determine the willingness of the landowner or coal miner to alter mining and reclamation procedures slightly to ensure that the impoundments have features conducive to fish and wildlife use, e.g., shallow littoral zones for fish spawning, growth of cattails for muskrats, or islands for duck nesting, and so forth, that can be created in strip mine ponds by dumping a few shovelsful of nonpyritic overburden material onto the bottom of the last cut.

9. Ensure that the plans for surface coal mining operations include provisions to prevent, to the extent possible, and using the best technology currently available, additional contributions of suspended solids to stream flow or runoff outside the permit area.

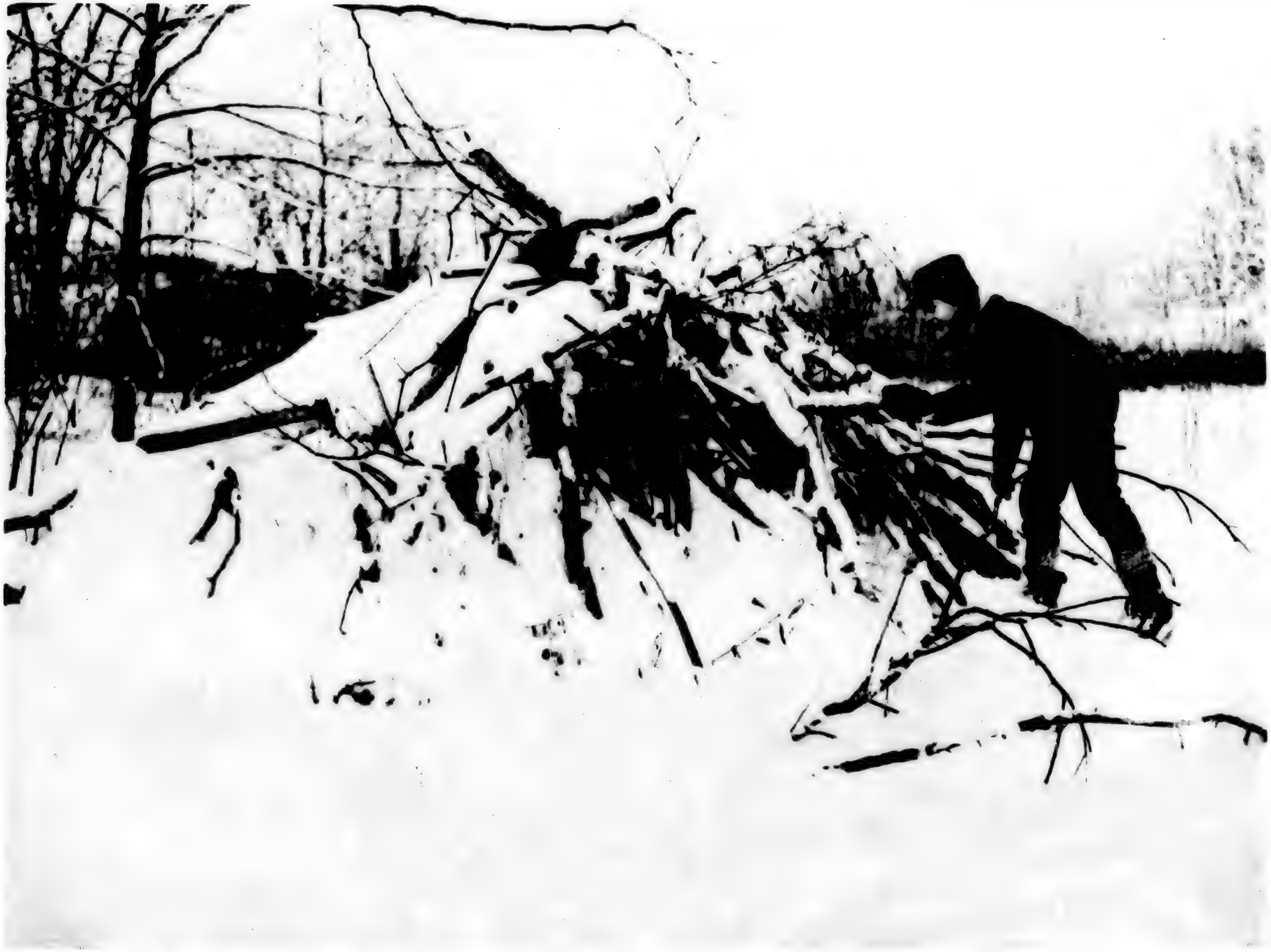


Figure 16. Voluntary reclamation of strip-mined land by responsible coal companies often provides habitat for wildlife. This snow-covered brushpile is a beaver lodge standing in a lake formed when the last cut of a strip mine was allowed to fill with water. (Photo, National Coal Association.)

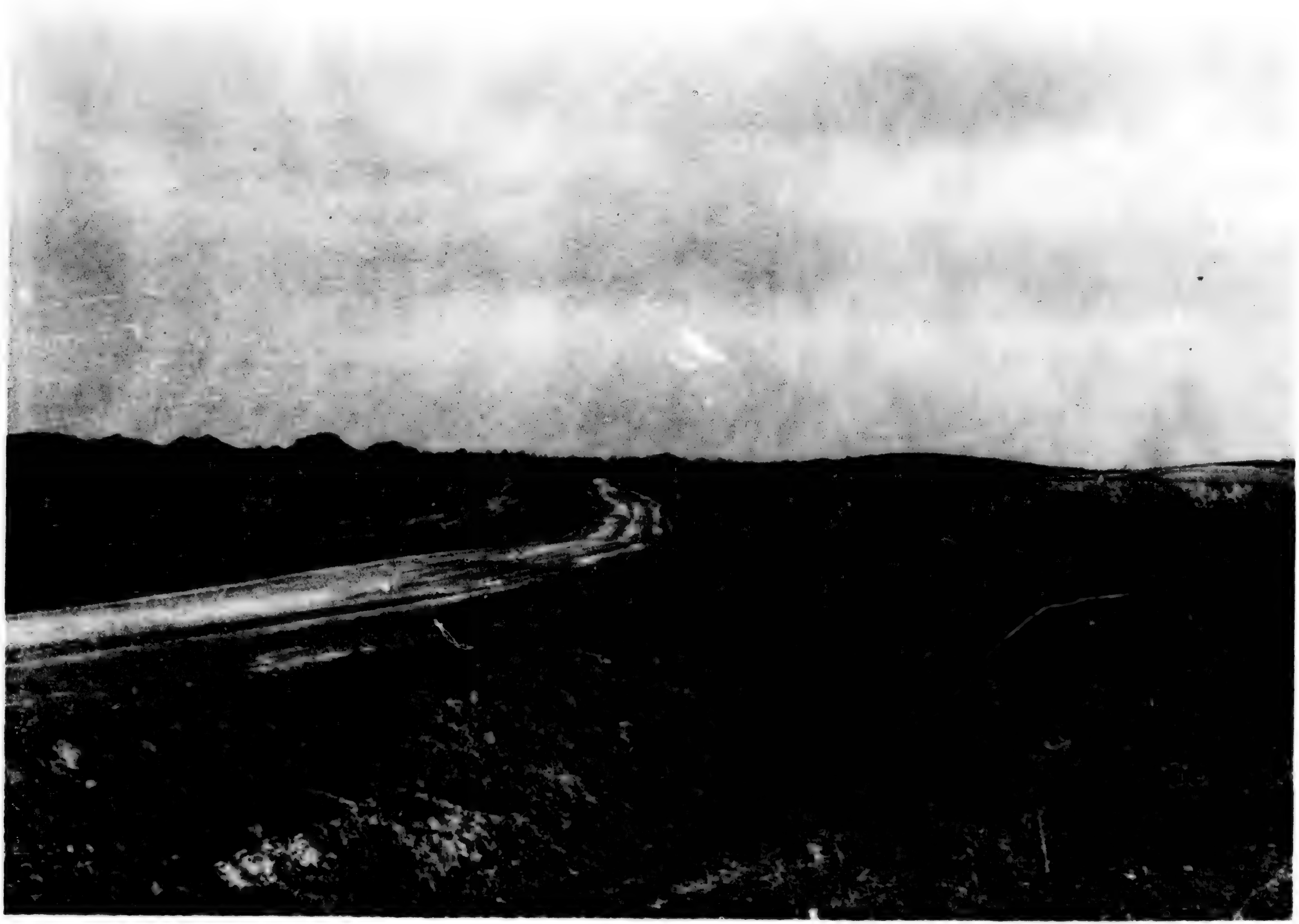


Figure 17. Haul road on unstabilized site. (Photo, D. L. Leedy.)

Figure 18. Cottonwood and Russian olive trees and native grasses line a strip-mine pond. (Photo, National Coal Association.)

10. Determine whether the land to be mined meets the criteria for suitability or unsuitability for mining as developed by the respective states and the U.S. Department of the Interior.

11. Ascertain whether or not requirements for applications for exploration for coal meet the requirements of the Act and whether plans for exploration activities will jeopardize threatened or endangered species or their critical habitats.

12. Describe the existing, premining resources on the area to be mined and areas to be affected, including surface and groundwater resources, vegetation, and fish and wildlife.

13. Designate the locations of lands to be used as reference areas for judging postmining revegetation success.

14. Show on a map each facility to be used to protect and enhance fish and wildlife and related environmental values and the location of water and air quality and wildlife monitoring points.

15. Discuss how management techniques and monitoring methods will be used to protect critical habitats of endangered or threatened species, and other protected species, and habitats of unique value for fish and wildlife, if fish and wildlife habitat is not a designated land use.

16. In agricultural areas to be mined and used again for agriculture after mining, include in the reclamation plan, when feasible, provisions for establishment of field and woodland borders composed of plant species that contribute to habitat diversity for wildlife.

17. In choosing the postmining land use option, consider those features or requirements for reclamation which may be suitable for fish and wildlife habitat and forestry but may not be suitable for row-crop agriculture. These include steepness of slope, stoniness of the surface, pH of the soil, and soil too dry or too wet for productive agriculture. In this connection, also consider the cost of initial reclamation and cost of continued applications of soil amendments.

18. If fish and wildlife habitat is selected as a land use, plan for revegetation of the area after mining so as to promote use of the area by the desired species or communities of wildlife and, at the same time, control erosion.

19. If commercial forestry is chosen as the postmining use of the land, include some tree species especially valuable to wildlife in addition to those normally used as commercial planting stock.

20. Ensure that topsoil will be piled separately in removing the overburden and used as promptly as possible in reclamation programs so soil microorganisms are not lost through long storage and drying of the soil.

21. See that the reclamation plans include measures for burying or otherwise handling toxic materials to prevent problems of acid mine drainage.

Figure 19. Pond with island on surface mine in southern Illinois. (Photo, D. L. Leedy.)

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Figure 20. Opening in wooded surface-mined area. Bicolor lespedeza shrub planting is visible on left. Much sweet clover is present in early summer. (Photo, J. Nawrot.)

FOR LANDS BEING MINED OR ONLY RECENTLY MINED AND NOT YET VEGETATED

1. Review the points in the above lists for those applicable to areas being mined or only recently mined and unreclaimed.

2. Note, particularly, the results of spoils analysis, including pH, stoniness, texture, amount of fine soil material present, and the presence of pyritic materials.

3. Note the height of highwalls and whether there are any mined mountaintop areas that are inaccessible to species such as white-tailed deer because of highwalls.

4. Locate on maps the presence of any strip mine ponds.

5. Determine or note the water quality, depth, and morphology of any strip mine ponds present on the area.

6. Identify sources of acid mine water drainage and determine, or review information available on, the extent of acid mine water pollution and of sedimentation in streams draining the mined area.

7. Develop data or review information already compiled on lands established as reference areas to determine the type of biological communities occurring on the area before mining. If woodland is selected as a land use option, this analysis will indicate the types of trees or other vegetation best suited to the area.

8. Determine or summarize information on the land use, cover conditions, and fish and wildlife populations present on areas adjacent to the mined site. Wild animals present on adjacent areas are those most likely to invade the reclaimed mined area.

9. Point out to the landowner the potentials of the area for fish and wildlife and determine the extent to which the landowner wishes to emphasize fish and wildlife management as a postmining land use.

10. Follow through on planning suggested above for areas to be mined if fish and wildlife habitat is chosen as a land use option. In this regard, if impoundments suitable for fish and wildlife enhancement are present and are causing no harmful effects, they should be retained in the reclamation process.

11. Determine how the newly mined area can be made to complement or supplement fish and wildlife habitat present in adjoining areas.

FOR ABANDONED AND UNRECLAIMED MINE LANDS

1. Review points made in the above checklist in connection with other categories for their present relevance.

2. Evaluate conditions on the abandoned area in relation to the priorities set forth in P.L. 95-87 concerning need for reclamation, including hazards to human life and health, damage to property and degradation of the environment to the detriment of the public.

3. Determine the extent to which the area is continuing to contribute to the offsite pollution and sedimentation of streams.

4. Indicate on a map any sources of pollution or areas of accelerated erosion.

5. Determine the extent to which the area has been revegetated and show on a map any bare spots which may require special attention. Describe the vegetation and evaluate it from the standpoints of woodland and of wildlife habitat.

6. Show the location of any strip mine ponds on a map and describe these ponds from the standpoints of water quality, depth and contour, and suitability for fish production; and use by waterfowl, shorebirds, fur animals, and other wildlife.

7. Analyze results of fish and wildlife surveys of the area for species diversity, populations, and fish and wildlife management potential.

8. Determine whether the area has high or low priority for reclamation in terms of the Act. If the area has low priority for reclamation, determine, with the landowner, the desired use of the land without reclamation assistance.

9. Identify those sites most in need of management attention if the desired use is for woodland and/or fish and wildlife habitat.

10. Consider ways of diversifying the habitat, e.g., constructing permanent impoundments, planting shrubs in old fields or areas with primarily herbaceous cover, and developing travel lanes for wildlife.

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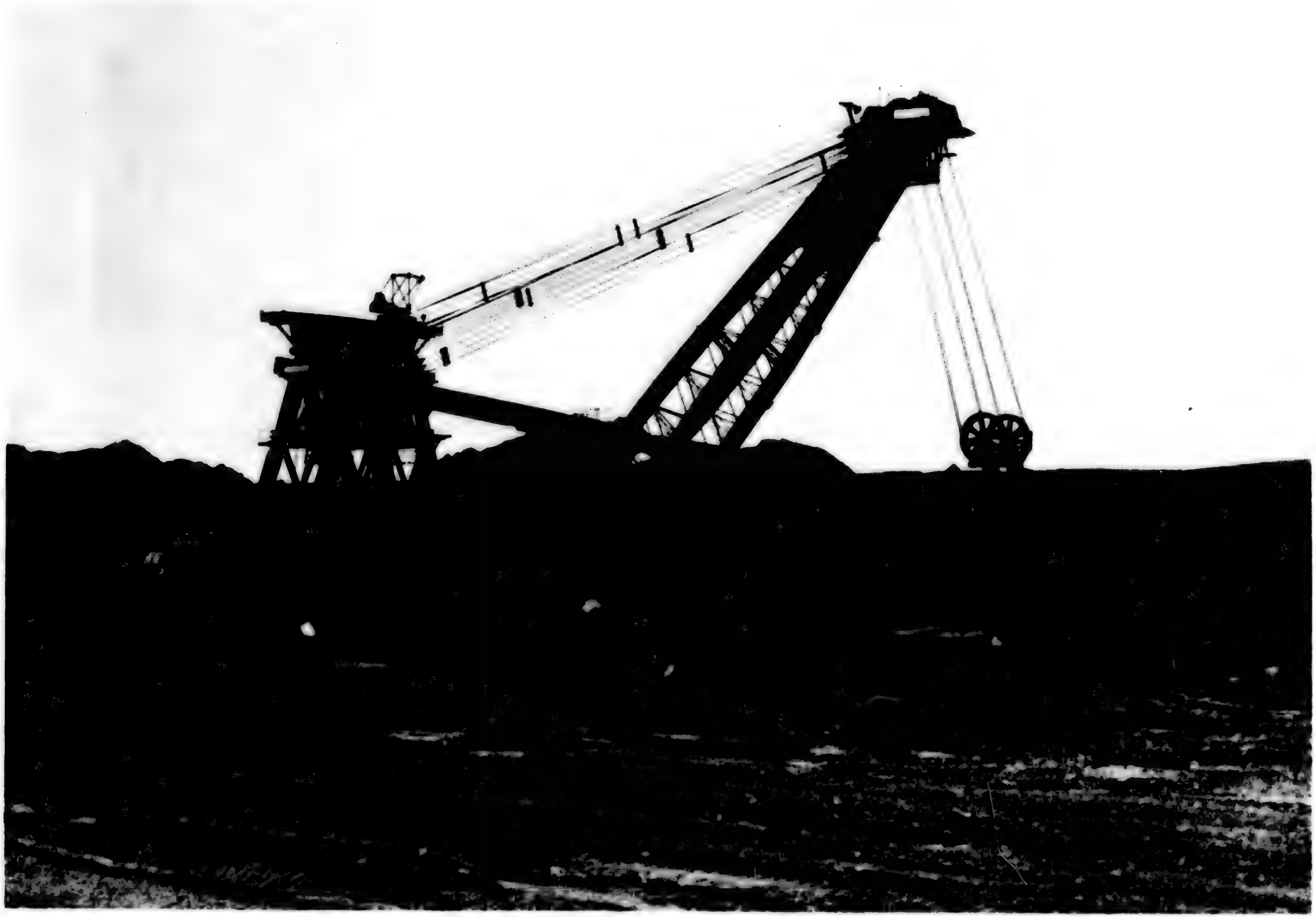

Figure 21. Area mining in southern Illinois. (Photo, D.L. Leedy.)

Reclaimed coal strip mines often provide prime fishing. This lake is at the Chinook Mine in Clay County, Indiana. The county had more than 2,000 acres of lakes on land reclaimed by the coal industry as of 1967. (Photo, National Coal Association.)

PART 3

Management of Particular Habitat Components for Fish and Wildlife in Relation to Surface Mining and Reclamation

General

This section assumes that information needed for applying for the mining permit-reclamation plan has been assembled (see Part 1); that the checklists on fish and wildlife planning provided in Part 2 have been considered; and that a decision has been reached by the landowner or operator to protect, enhance, and manage wildlife in connection with the mining and/or reclamation operation. It assumes, also, that provisions have been made to conform, to the extent possible—through use of the best technology currently available (BTCA)—to the environmental protection performance standards set forth in the Act, particularly as regards the control of erosion and pollution and the revegetation of surface-mined areas. The Office of Surface Mining in the U.S. Department of the Interior and the respective state regulatory authority will have major roles for determining BTCA. Our purpose here is to suggest ways of benefiting fish and wildlife in conjunction with erosion and pollution control, soil and water management, and the revegetation of mined areas. More specific suggestions for fish and wildlife habitat management in different regions and under various situations will be included in Part 4. Suggestions made here apply generally to management practices for soil or spoil, water, and vegetation and their interrelationships.

Management of Surface Mine Soil and Spoil

Management of surface mine soil and spoil is treated in more detail in Volume I of this report. The nature and extent of topsoil and other overburden above the coal seam, and the manner in which they are handled, have a direct bearing on the capability of the mined area to support vegetation. Usually it is desirable to pile the topsoil separately and use it as soon as possible so the soil microorganisms are not killed while the soil is stored. Acid-forming materials exposed during the excavation generally should be buried so as to reduce acid mine drainage which degrades water quality in the receiving streams. These toxic materials are best buried high on the grade away from potential contact with water. If the spoil material is graded, it should be remembered that long, smooth slopes are subject to erosion. Also, if the spoil contains plastic clays and is compacted into a smooth surface, rainfall retention and infiltration are less than when slopes are left in a rough or furrowed condition, with the furrows on the contour. A rough surface results in better survival of planted trees and shrubs.

Some variation from the original landform can be beneficial for fish and wildlife, and a good case can be made for creation of permanent impoundments or perhaps exceptions to other requirements of the Act. When an impoundment, for example, is approved in the mining permit-reclamation plan, it is probable that time and money can be saved by creating the lake when excavating the coal and regrading the spoil surface.

Soil erosion, sedimentation, and often acid mine water pollution, can be prevented or reduced by quick revegetation of the spoil surface, use of various drainage and diversion devices, spoil amendments, sediment ponds, and other means.

In the case of older "abandoned" mined areas, the source of erosion usually can be detected during, or immediately following a heavy rain, by locating delta-like silt fans in the receiving waters and following gullies back to their sources. In areas with contour mines, if the gully carrying suspended materials to a stream continues on to the bench, much of the water clearly comes from there and should be diverted to a pond, natural watercourse, or erosion-proof drainway. More vegetation will help and may solve the problem in all but the heaviest rainstorms.

When erosion occurs on the bench, but sediment is being deposited in an existing pond without leaving the mine site, conditions for fish production can be improved by establishing better vegetative cover and installing one or more sediment ponds above the main pond. In area mining, the runoff is chiefly internal within the perimeter of the mined site. Therefore, while erosion may be severe and the sediment deposited in strip mine lakes, off-site damage from erosion is minimal.

If the bottom of a stream draining an older mined area is orange, the water is probably acid. Testing the water with litmus paper or a field kit available from the local county extension agent or SCS office can give some indication of the water's pH, but more sophisticated techniques are desirable to determine pollution problems which may exist. Sources of acid water draining into strip mine ponds or streams should be pinpointed if possible, and steps taken to control the pollution. Approaches to controlling acidity include

Figure 22. Autumn olive planting in old field in eastern Tennessee. (Photo, T.M. Franklin.)

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Figure 24. One of a series of holding basins to contain sediment from runoff until revegetation has stabilized conditions. Scene is at Rowland mine of Consolidation Coal Co. in McDowell County, W. Va. (Photo, National Coal Association.)

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erosion control through revegetation and other means mentioned above and raising the level of strip mine ponds to cover acid-producing strata. Use of "gob" in constructing haul roads is discouraged because this material may be a source of pollution.

Water Management

Protection of Existing Streams and Ponds on Areas to Be Mined

In areas to be surface-mined, every effort should be made to protect existing waters from acid mine drainage and sedimentation. Buffer strips of vegetation along streams help reduce erosion and sedimentation. The higher plants overhanging the water provide shade—preventing extremely high water temperature—and they provide habitat for insects, some of which drop into the water and are eaten by fish and other aquatic organisms. It has been suggested that to be effective for shade and temperature control vegetation must be twice as high as the distance to water. For erosion control, the width of the buffer strip must be increased in relation to the steepness of the slope along which drainage from the watershed occurs. P.L. 95-87 calls for a minimum buffer strip of 100 feet between the mining operation and the water body.

Siting and Construction of New Impoundments

In areas to be mined, creating permanent impoundments should be considered. In addition to providing habitat for fish and other aquatic species, ponds and lakes provide constant water for terrestrial wildlife; they increase habitat diversity; they enhance the appearance of an area; they provide recreational opportunities in the form of fishing, boating, camping, picnicking, and sight-seeing; they help control runoff from surface-mined areas, thereby alleviating downstream water quality problems; and the waters of some ponds have potential for the commercial culture of marketable fish. In some areas the ponds could provide a source of water for fire-fighting. Landowners who may wish to make the pond and surrounding area available to the public for recreation, and perhaps charge a fee, should determine from state authorities their liability for drownings or other accidents on the property.

In area-mined sites, potential locations for impoundments are the valleys between ridges of spoil where there are springs, the last cut made in mining, and drainageways blocked by haul roads. In contour mined areas, an optimum location is a wide (200 feet or more) portion of the bench where a natural drainage outlet or flow from a small spring crosses it. Also, ponds can be located in the pit area against the highwall.

The soil of a pond site should contain a high percentage of clay to ensure it will retain water, prevent saturation of the spoil, and not result in an unstable outslope subject to landslides and sloughing. The pond bottom materials should have a pH of 5.5 or above. Information on the capacity of ponds needed to accommodate different peak discharges from the watershed, and on details of pond construction for water supply and recreation is given in *Agriculture Handbook No. 387* of the U.S. Department of Agriculture. Generally speaking, the pond size depends on water source, watershed area, underlying material, bench size if in a contour-mined area, and landowner preference. Spring-fed ponds need have a maximum depth of only 7 to 8 feet (2.0 to 3.5m); ponds depending on runoff may need a depth of 15 feet (about 4.5m) to ensure adequate water during dry periods.

Before constructing the pond, the watershed should be inspected for the presence of exposed acid-forming materials. If such materials are found, they should be buried. Also, if strata containing such materials are found along the edges of the impoundment itself, care should be taken to maintain the water level high enough to cover exposed acid forming strata. Also, vegetation should be established on the watershed if it is not already present, to reduce the amounts of sediment and acid mine water entering the pond.

The design of ponds best suited for fish production differs from that most suitable for many wildlife species. Bottom organisms which contribute significantly to the diet of fishes grow best in shallow water; also, many fishes spawn in shallow water. To maximize fish production, therefore, care should be taken to shape the pit so there will be adequate shallow water. At the same time, it is important that water at the shoreline be two feet or more deep to prevent the growth of rooted aquatic plants undesirable in fish ponds.

On the contrary, if the landowner wishes to enhance conditions for nesting water birds, muskrats, amphibians or a variety of other wildlife, it is desirable to shape the pit so that there will be extensive areas of shallow water and gently sloping shores conducive to the growth of emergent plants. Such plants provide both food and cover to many wildlife species.

Ponds for fish production may be as small as one-fourth acre (0.1 ha). Ponds equally small or smaller may be valuable to wildlife as sources of drinking water. Even ponds that contain water only a part of the year are important to wildlife for drinking and also for the aquatic vegetation that grows in them. On the other hand, ponds of 10 to 20 acres can be of more value for multipurpose uses. Water of quality desirable for fish and wildlife enhancement also is suitable for most

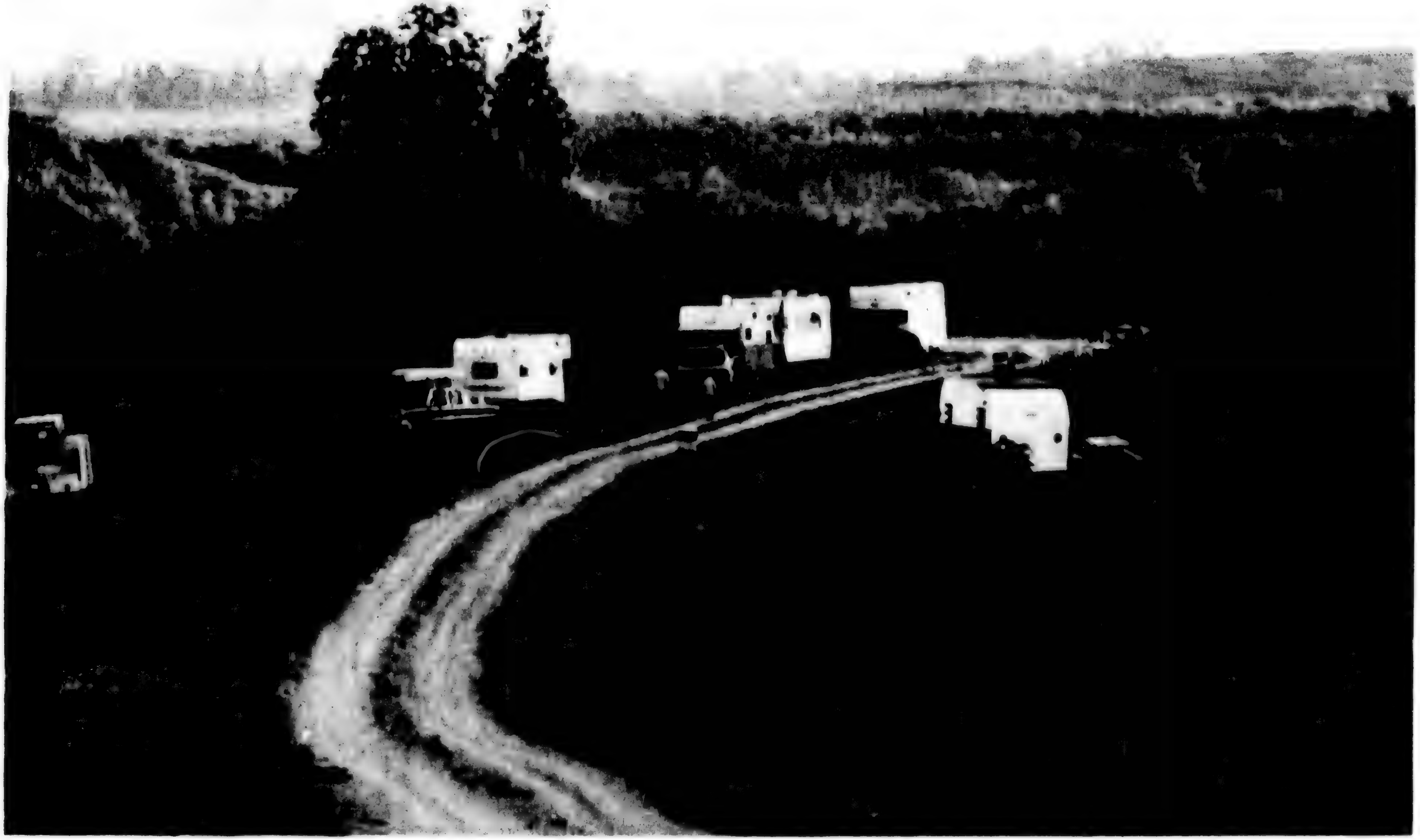

Figure 25. Campers occupy a public campground on reclaimed strip-mined land in southeastern Ohio. The company which mined and reclaimed the land has provided picnic tables, sanitation and water. (Photo, National Coal Association.)

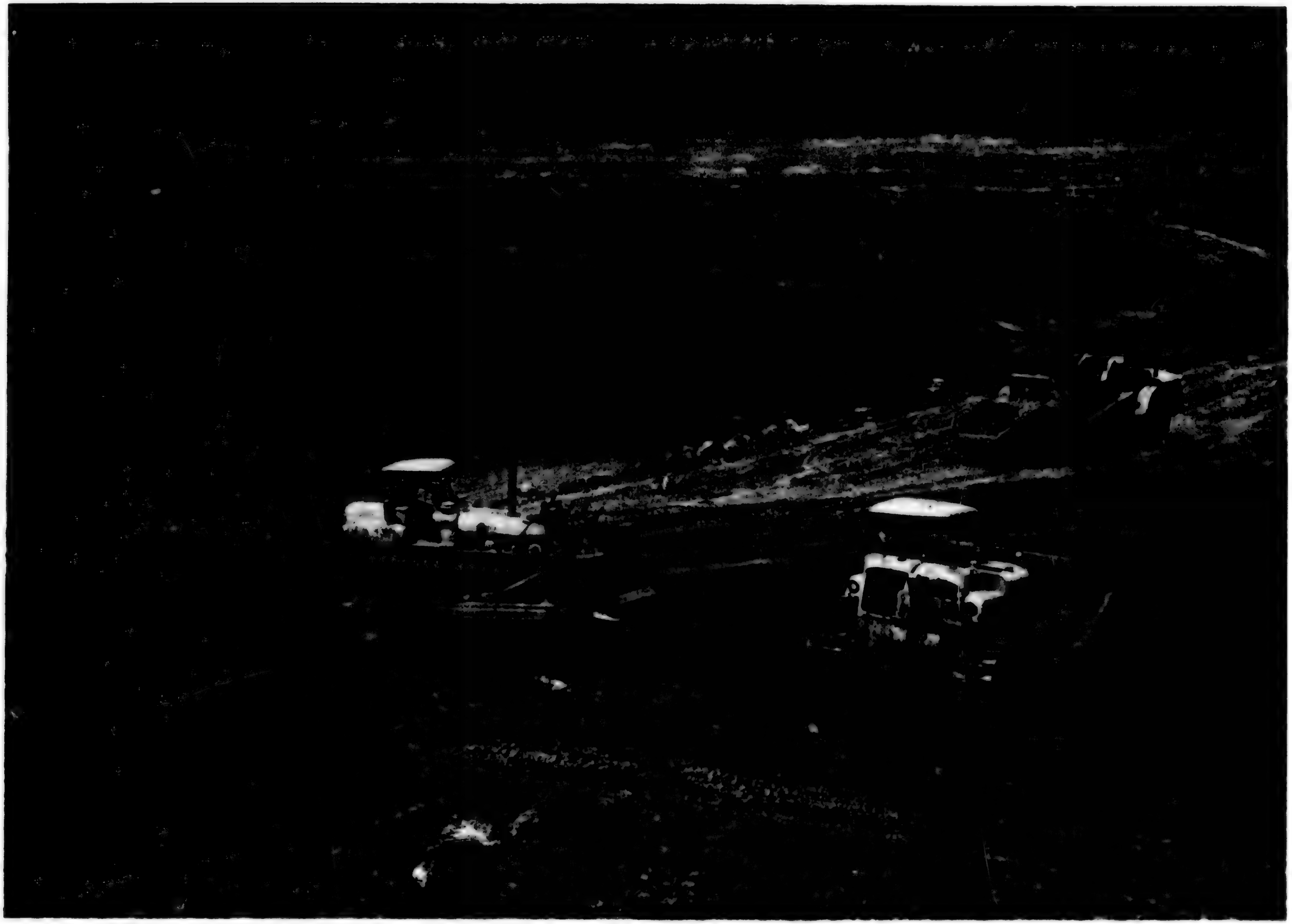

Figure 26. Coal companies recognize the growing need for outdoor recreation grounds. Hanna Coal Co., Division of Consolidation Coal Co., a large strip mine operator in eastern Ohio, provides fishing holes wherever possible on land it has disturbed while mining coal. (Photo, National Coal Association.)

other uses. Use of water for fish and wildlife ordinarily would not diminish the quantity and quality of water available for other uses in adjacent areas. Hence, careful consideration should be given to the feasibility of including in the reclamation plan provisions for establishing permanent impoundments as authorized by P.L. 95–87.

Streams and Ponds On Existing Surface-Mined Areas

It is desirable to determine the physical, chemical, and biological characteristics of streams and ponds on existing surface-mined areas. Some of them may be badly polluted, degraded by sediment, or have low biological productivity or few desirable forms of life. Others may be in good condition and produce desirable forms of fish and wildlife. The productivity of streams and ponds should be maintained, i.e., every effort should be made to protect them if it is necessary to do any reclamation work on the area. On the other hand, there may be many opportunities to improve the nonproductive streams and ponds. Some suggested approaches are discussed in the next two subsections.

Pond Management

New impoundments should be designed according to their proposed uses, e.g., for fish or for waterfowl, wading birds and shore birds, aquatic fur animals, or multipurpose uses. On larger impoundments, especially those equipped with water level control devices, it is possible to accommodate the needs of both fish and wildlife. If ground water and surface water drainage conditions permit, permanent impoundments or marshes can be established. In such situations, installing water level control facilities offers considerable flexibility in management. For example, drawdowns can encourage plant growth or permit the seeding of food plants attractive to waterfowl and other birds in the fall and winter. If cover is too abundant in relation to open water, raising water levels can kill cattails and other emergent plants. Dropping the water level in an impoundment overpopulated with stunted panfish will force many of these forage fish into areas where predator fish can get them.

In the purposeful development of lakes in surface mined areas, dumping some nontoxic spoil in the mine pit so it rests above the water level creates islands. This increases edges and provides for additional habitat diversity. These islands are used by waterfowl for loafing and nesting sites and by other wildlife. Circular islands as small as 10 feet in diameter have been used by ground-nesting ducks.

Ponds already existing on surface-mined areas can be improved in several ways. For fish production, water depths of 5 to 6 feet or more are desirable. If the water is too shallow, as when a pond has been partially filled with sediment, some bottom material can be removed. If the pond is in a mine pit with a rock bottom, it may be possible to raise the water level by installing a dam. In some situations where the pond's watershed is too small to provide the needed amount of water there may be opportunities for redirecting some additional runoff into the pond. On the other hand, if the water is too deep, or with little gravel or littoral (shallow marginal area), the opposite of these measures may be feasible. Because of the danger of winterkill of fish in areas of winter ice formation, some parts of the pond should be deep enough that water with good dissolved oxygen content remains during the most severe freezes.

If the pH of the water is 4.5 to 6.0, adding lime can bring the level to pH 6 or higher which is the level needed for good fish production. With a pH of 4.5 or lower, water is too acid for fish production and, although the pH can be increased by lime, repeated applications may be required to maintain the desired level. If water quality is favorable for fish, i.e., the water has the proper pH, is not turbid, and contains adequate nutrients, the owner may wish to consider enlarging the pond.

Before altering the size or depth of ponds, however, a decision should be made as to whether fish production or use of the pond by waterfowl, muskrats or other aquatic species is to be encouraged. For many of the latter, shallow water areas favorable for the growth of emergent vegetation are desirable.

If there is a loss of water from the basin of an existing pond—a problem which often occurs—it may be desirable to drain the pond and apply some kind of sealant on the pond bottom. Compacting clayey material such as bentonite on the pond bottom frequently is successful. Other materials used for sealants include fly ash, hydrous metal oxides, and certain gels. Plastic sheeting and rubber liners are sometimes used and, if the leak can be identified as a crack, fissure, or auger hole, tar or concrete can be applied.

Other approaches to the management of surface mine ponds, including liming and fertilizing, fish stocking, fish population control, creation of spawning beds, installation of nesting boxes or platforms for birds, plantings, and artificial floating islands or rafts will be discussed in later sections of this report.

Stream Management

Two obvious objectives of management for streams in or affected by surface mining areas for coal are control of erosion and sedimentation and acid mine water

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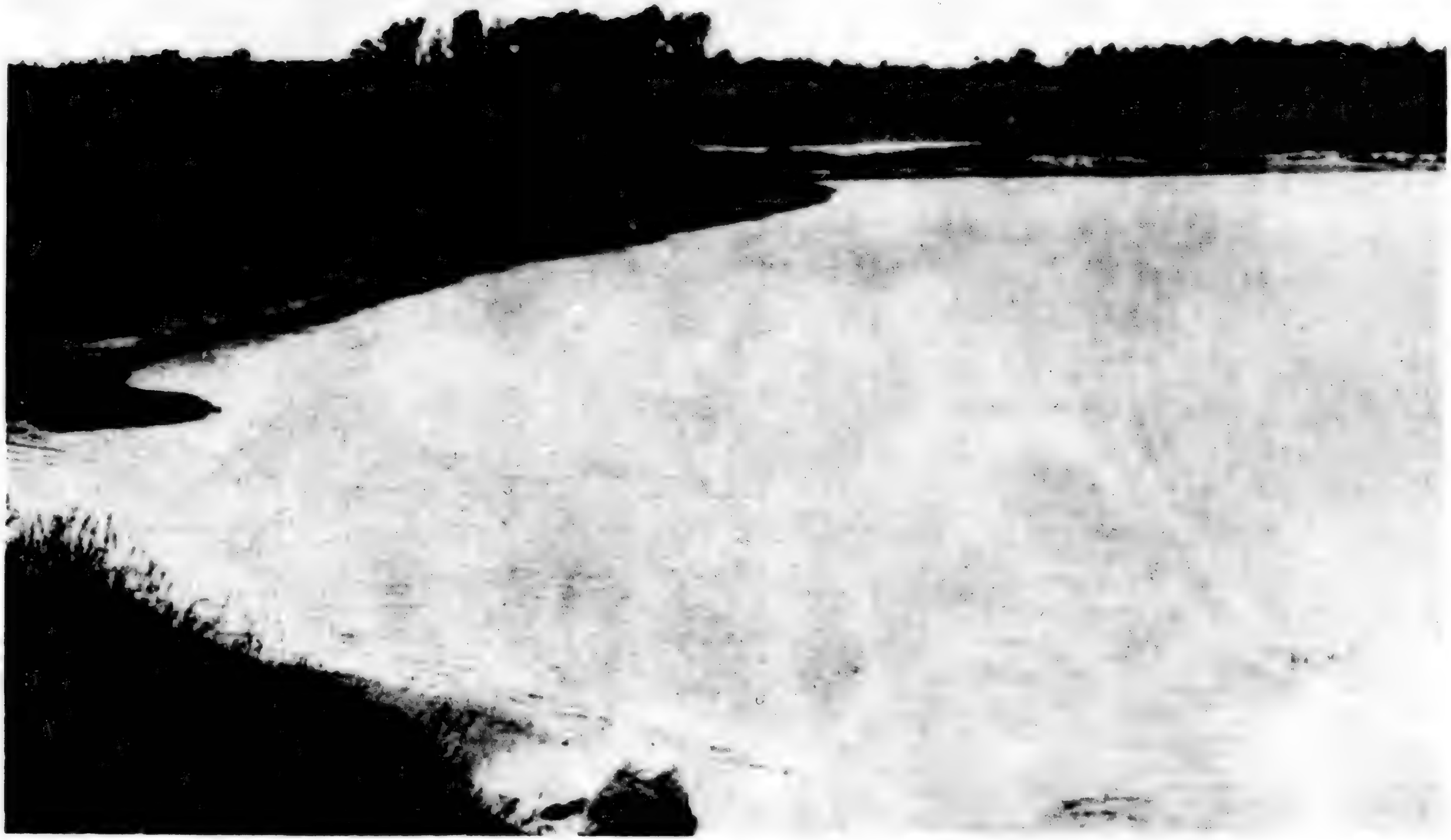

Figure 27. Pond with banks deliberately flattened for waterfowl use in Southern Illinois. (Photo, D. L. Leedy.)

Figure 28. Permanent pond constructed on surface mine site. (Photo, U.S. Forest Service.)

Figure 29. Pond with islands attractive to waterfowl in Southern Illinois. (Photo D. L. Leedy.)

Figure 30. Permanent pond for fish and wildlife on TVA/USFWS demonstration area in eastern Tennessee. Note ditch diverting water to impoundment. Also note plantings on slope at right. (Photo by T.M. Franklin.)

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drainage. If streams can be kept free of accelerated sedimentation and of acid mine waters stemming from the erosion and runoff or seepage from mined areas, they produce fish and wildlife, add greatly to the aesthetic and scenic values of an area, and provide opportunities for fishing, hunting, trapping, and canoeing. If woody vegetation is present along streams, the wooded waterways serve as natural travel lanes for wildlife.

Through dilution, because of the replacement and flow of water, and through chemical-biological interactions, streams have a natural capacity to assimilate considerable amounts of wastes. Silt deposited in streams is flushed out by occasional highwater flows. However, the self-cleansing ability of a stream both at the mined site and for some distance downstream often is overtaxed by continued heavy sediment deposits and by acid mine water drainage. Inasmuch as stream flow is maintained largely by groundwater, acid may enter the stream from this source when water percolates down through acidic spoil banks and into the flood plain. Heavy siltation and pollution of a stream can essentially eliminate fish and fish food organisms from the affected portion.

When fish and fish food organisms have been lost from a stream, their recovery depends on improvement in stream conditions and the presence, nearby, of healthy tributaries or sections of stream. These healthy stream areas, especially those upstream from a mined area, serve as reservoirs and nursery areas for fish and other aquatic organisms which will repopulate a depleted area when conditions are favorable. Repopulation of an area from downstream may be prevented by a dam or waterfall. Thus, it is particularly important that abandoned mines which affect headwaters be reclaimed, since these headwaters are critical to downstream health and recovery. Postmining use for forestry and fish and wildlife management are likely to result in the need for less regrading and soil disturbance, and hence less sedimentation, than use for row crop agriculture.

Stream channelization is prohibited by P.L. 95-87. Portions of streams that have been channelized in past mining operations can be improved by installing instream rehabilitation structures such as deflectors and check dams. Creation of pools for resting places and shelter for fish is another means of stream management. When the spaces between stream bottom gravels used for fish spawning are filled with, or cemented by, fine sands and silts, gravels may be loosened mechanically by raking, harrowing, or disking at times when the eggs and larvae are not in the gravel. These and other stream improvement methods are described in the U.S. Forest Service's *Wildlife Habitat Improvement Handbook,* issued in 1969. Technical advice on stream habitat improvement for fish and wildlife can be obtained from Fish and Wildlife Service, state, SCS, or Forest Service biologists.

Vegetation management in relation to streams, means for neutralizing acid streams, and stocking will be discussed in Part 4 of this document.

Vegetation and its Management

General

Vegetation in one form or another is crucial to fish and wildlife. Vegetation management constitutes the primary means of managing wildlife. For areas to be used for forestry after mining, a long-term commitment is assumed, but even for short-term alternatives, food plots established on recently mined areas, or brush piled on such areas for cover, improve conditions for wildlife. Revegetation of a surface-mined area, therefore, probably is the most important single step that can be taken in reclaiming the area unless it is to be used for landfill, parking lot, or building sites, as are many of the areas surface-mined for gravel or other construction minerals in urban areas. However, planned revegetation of a mined area requires considering soil and water and other environmental factors, as well as the proposed postmining use of the area.

Although the primary focus in this section will be on vegetation management for fish and wildlife, the need for vegetation for erosion control, timber and crop production, aesthetics, and other purposes is recognized. Also, wildlife can cause the spread of such plants as multiflora rose which, although valuable for wildlife, are now generally regarded as undesirable in agricultural areas. Obviously, plant communities, along with the animals dependent upon them, vary markedly according to their location.

For wildlife, the diversity of vegetative cover, including the extent of edges created by having one type of cover next to another, is usually of much importance. Diversity of cover can be attained by planting, or encouraging the growth of evergreen plants within a plant community of deciduous species; by disking old fields dominated by bunch grass to encourage the growth of annual weeds; by planting shrubs within tall-canopied forests to create another layer of vegetation; and by other means. In general, large tracts of uniform forest, large expanses of surface-mined land reclaimed by grading and seeding to Kentucky-31 tall fescue, or large fields devoted to growing corn or soybeans, are not conducive to wildlife production. The tracts of uniform forest can be improved by creating openings within them, the tall fescue tracts by planting shrubs, and the agricultural areas by creating woody field borders of fencerows.

Figure 31. Edge of this pond is shallow with growth of emergent vegetation. Wood duck box was erected on small sycamore at left of photograph. (Photo, U.S. Forest Service.)

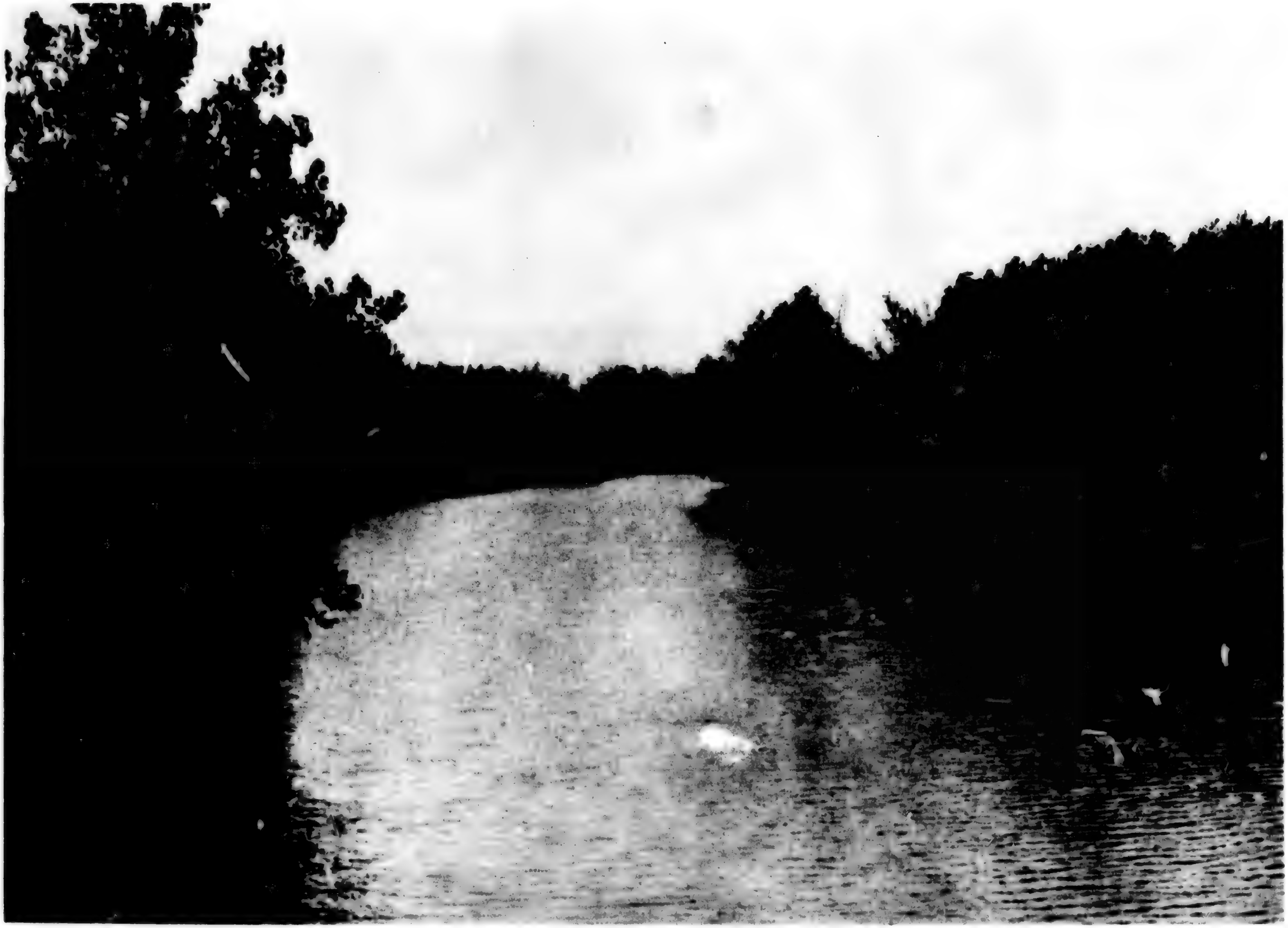

Figure 32. Wooded waterway is a natural travel lane for wildlife. (Photo, U.S. Forest Service.)

Figure 33. Check dam creates pool. (Photo, D.L. Leedy.)

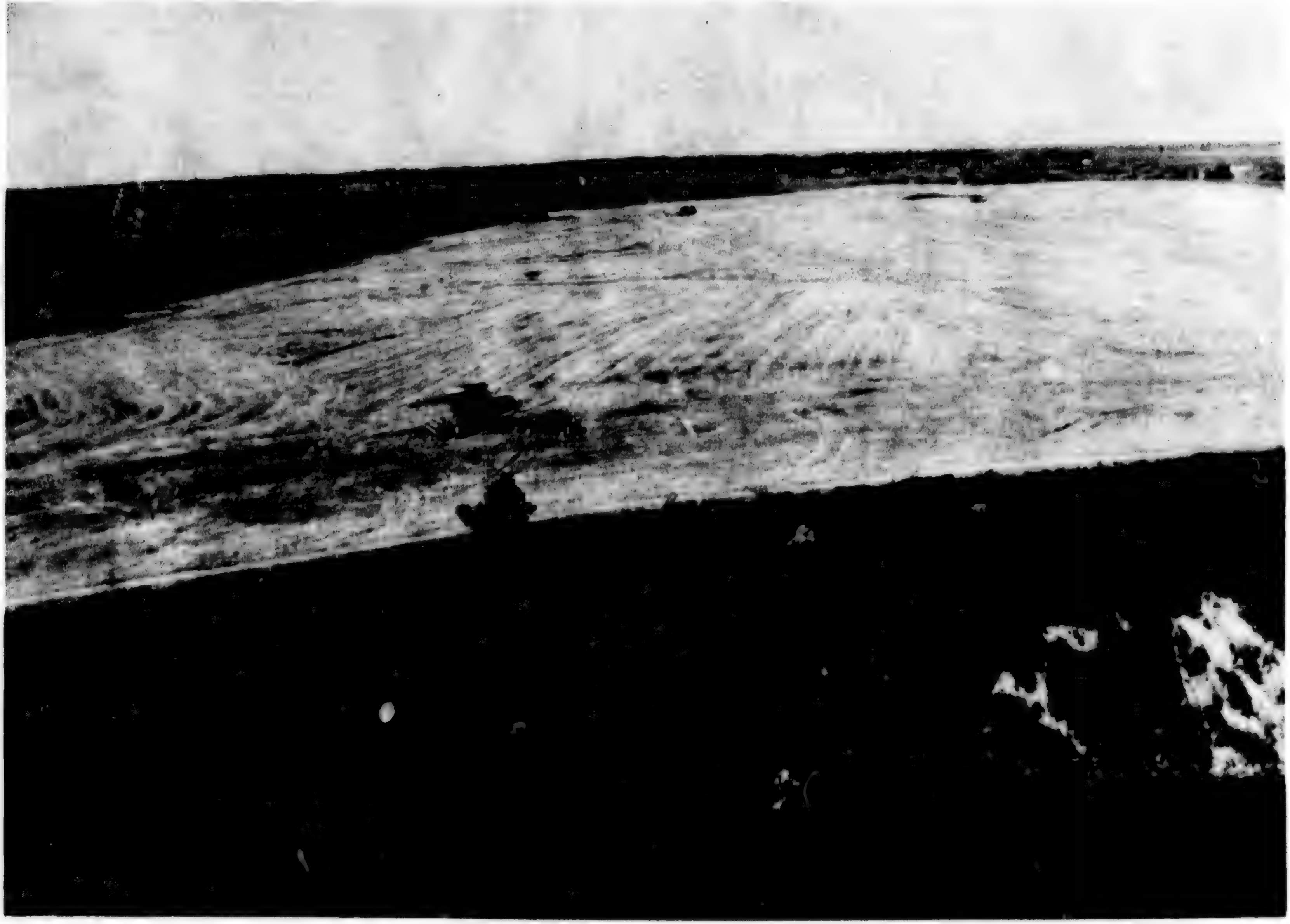

Figure 34. Everything in sight, including the lake in the foreground, was once mined land. Now the land has been returned to agricultural use, and has been producing wheat for several years. (Photo, National Coal Association.)

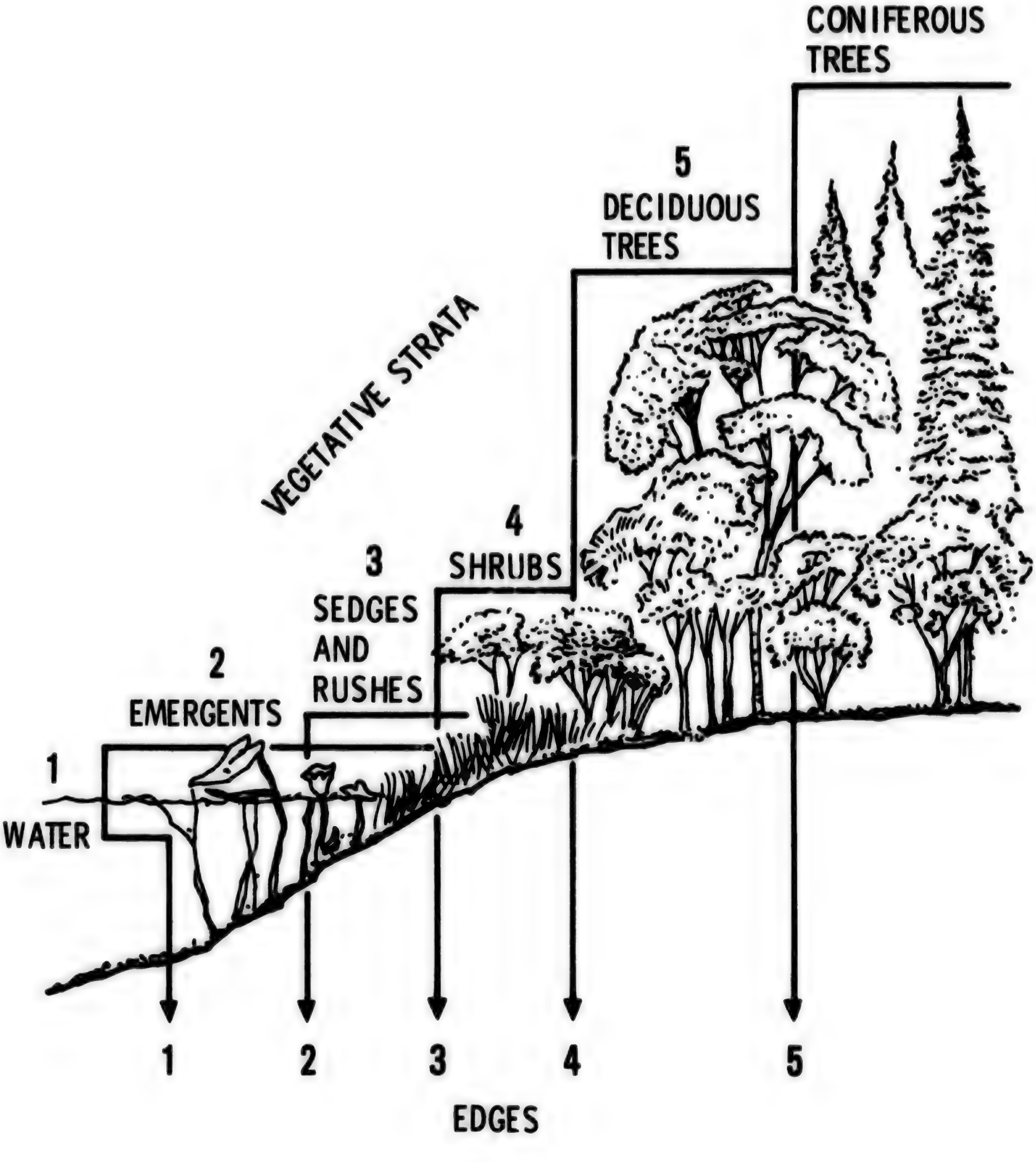
CONIFEROUS TREES
5
DECIDUOUS TREES
VEGETATIVE STRATA
4
SHRUBS
3
SEDGES AND RUSHES
2
EMERGENTS
1
WATER
1
2
3
4
5
EDGES

Figure 35.

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Figure 36. Leveled off strip-mined bank in area mined 39–40 years ago. Some sericea lespedeza planted in 1956 still remains. (Photo, D. L. Leedy.)

Vegetation within the various tracts can be too dense for optimum wildlife usage; ground-dwelling species must be able to move through the cover, find places to nest, and have access to seeds, insects, and other food found on or near the ground.

Various suggestions for means of managing cover for wildlife are given in the following subsections. Although it is recommended, when possible, to use native species of plants in revegetating surface-mined areas, obtaining seed and planting stock for such species may be difficult. Therefore, to reduce the time required for invasion of native shrubs or trees onto a surface-mined area to be managed for wildlife, it may be desirable, in some cases, to use certain exotic species, including especially autumn olive.

Volume I includes references to many publications dealing with the revegetation of surface-mined areas. The publication, *A Guide for Vegetating Surface-Mined Lands for Wildlife in Eastern Kentucky and West Virginia,* will be helpful with respect both to selecting species and specifics on planting in the region. It can be obtained from EELUT (see Preface).

Included in the present volume are: Appendix B which lists plants under categories of trees, shrubs and vines, and herbaceous plants valuable for wildlife and recommended for wildlife habitat development on surface-mined land; and Appendix C which provides lists of recommended plant species and the names and addresses of suppliers of planting stock and seed.

Plant Succession and Vegetation Control

By plant succession, a disturbed, barren area, such as results from surface mining, becomes vegetated through successive stages towards a climatic vegetation type if left undisturbed for decades. This may be diagrammed for much of the eastern United States as follows:

annual weeds → perennial weeds → grasses → shrubs → trees

The stages in succession are not always sharp. Grasses may be found within the weedy stage and shrubs within the perennial weeds and grasses. However, in much of the East, a field, even when covered with grass at the start, eventually will become vegetated with shrubs and, finally, with trees. This may require 20 to 30 years for tree cover and up to 100 years for mature trees. Succession is likely to be slower on surface-mined areas than on areas with more favorable growing conditions.

Considered in geologic time, ponds and lakes are temporary. With accelerated erosion caused by man's disturbance of watersheds, they may be relatively short-lived in that they tend to fill up with sediment and organic material left by dying plants and other organisms until they become land. Observation of some ponds will show a progression from algae,

Figure 37. Clump plantings of wildlife shrubs and trees were made in this TVA demonstration area. Time required for invasion of natural vegetation was effectively reduced. (Photo, T.M. Franklin.)

submerged plants and some floating plants near the pond center, to emergent plants like cattails closer to shore, to sedges and reeds on the wet shore, and finally to grasses, brush and other terrestrial plants on the adjacent upland.

Each stage has value for wildlife and if several stages can be interspersed in a relatively small area, diversity in wildlife can be maximized. How to establish and then maintain vegetation in the desired stage to achieve wildlife objectives is the crux of wildlife management. Cutting, controlled burning and grazing, selective use of herbicides, and flooding are tools that can be used in vegetation control.

Annual weeds include many important wildlife food plants, such as ragweed, foxtail grasses, pigweed, lamb's-quarter, smartweeds, and nut grass or sedge. Disking is one way to keep the ground loose so that annuals keep coming back from the previous year's seeds. Planting a mixture of domesticated annuals such as German and browntop millet, cowpeas, soybeans, sorghums, buckwheat, and Korean lespedezas next to cover provides abundant food, but is more expensive.

Sweet clover and red clover, which may occur as weeds, are biennials, but many of the flowering weeds or forbs are perennials. Examples are the common milkweed, the white heath aster, Canada goldenrod, tall ironweed, common five-finger or cinquefoil, and Canada thistle. Perennials provide both food and cover.

Sericea and other lespedezas, timothy, brome grass, and some of the native prairie grasses, like bluestem, Indian grass, and switch grass, are among those perennials that can be planted with favorable results for wildlife. Annual mowing, done in late summer to minimize dangers to nesting wildlife, helps to maintain stands of perennials.

If the stands have reached the stage where they crowd out other vegetation and are too dense for most effective use by ground-dwelling wildlife, such as is often the case with fescue, thorough disking after mowing is recommended. Disking should be done on the contour in strips perhaps 16 feet wide and on a rotation basis to encourage a yearly supply of beneficial herbaceous plants.

On recently reclaimed areas that require seeding, low growing leguminous plants mixed with such species as weeping lovegrass and deer tongue and with plantings of bristly and black locust and black cherry can be used to simulate an old field habitat. Black locust and bristly locust serve as nurse trees for other species. (See Table 2 at end of chapter.)

When an area has too much thick brush or the brush has become too tall to provide the habitat desired, succession can be set back by cutting the brush with some appropriate type of heavy duty mower, or possibly by hand on small areas. If the area is then disked, annuals and perennial forbs and grasses will again invade the area.

Figure 38. Pond in late stage of succession on surface mine site in eastern Tennessee. (Photo, T.M. Franklin.)

Although controlled burning is an inexpensive way of controlling vegetation, it must be done very carefully and with professional advice. The Tall Timbers Research Station, Route 1, Box 160, Tallahassee, Florida 32303, has many publications on controlled burning and the ecological effects of fire. The state conservation department should be consulted with respect to permits and legal restrictions before any burning is attempted.

The same general precautions apply to using herbicides to control vegetation. With careful and selective use, herbicides can be effective for both terrestrial and aquatic plants. If an area is fenced, dense stands of grass and brush can be opened up by grazing cattle, sheep, or goats. The precaution here is to remove the livestock before too much of the vegetation is consumed.

In forested areas, timber harvesting, especially clear cutting, obviously sets back succession. Cutting opens up the woodland and promotes sprout growth valuable to deer and other species. Openings within a forest provide edges, especially when they are planted with or support legumes, grasses and other herbaceous plants. Vegetation within the openings is used directly as food and cover and is valuable for young quail, grouse, wild turkeys, and many other species because insects present on such vegetation provide food.

Although aquatic plants can be established in a wetland area through use of seed, tubers, or planting stock to speed revegetation of the area, water level control to create suitable growing conditions is likely to be more successful.

Vegetation Management for Selected Areas or Purposes

In a later section of this report, examples of suggested wildlife habitat management approaches for use on different types of surface-mined land will be discussed. Some of the suggested treatments involve vegetation management for features which many mined sites have in common. These include streamside and bottom lands, haul roads and other rights-of-way, and woods or field borders. Management of such areas is discussed here briefly to avoid repetition. Plant species recommended for seeding, planting, or encouragement on such sites are listed in Table 1.

Streamside vegetation: Mention has been made of the value of streamside vegetation. It helps control erosion, shades and cools stream waters, and provides insect food for fish and other aquatic organisms. Numerous other wildlife species prefer bottomland habitat and use stream border vegetation as travel lanes.

Freezing and thawing, ice, and water are the erosive forces that cut away banks, and when livestock are permitted to graze at will along streams, their trampling may be an added factor. Although stone riprap, jetties, and other structural devices are required to protect stream banks in some places, our concern is with vegetation, both as a means of erosion control and for its wildlife values. The importance of controlling the runoff from mined areas into streams has been stressed because this is where erosion control should logically start—on the watershed.

Vegetation along streams helps reduce streambank erosion. A heavy grass sod is fairly effective and the grass provides some seeds, forage, and cover for wildlife. Dense belts of willow trees several inches in diameter on the stream floodplain are more effective than sod in retarding current velocities of streams at flood stage, thereby reducing erosion by water and floating ice. Willows are adapted to growing along streams and are important food for beavers. Beavers aid in slowing down the velocity and trapping sediment in the impoundments they create by damming headwater streams.

Willows are among several plant species that can be used to stabilize stream banks and contribute to fish and wildlife enhancement. For diversity and as a precaution against plant diseases and the attack of insects which may damage plantings, it may be desirable to use a mixture of species in an attempt to simulate a naturally adapted plant community. Such species as red osier and silky dogwood and speckled alder may be used in addition to various willows. (See Table 1.)

Such plants can be established through direct seeding, as with alder in the fall; by cuttings planted in the fall and covered with bank mats of such materials as willow brush held in place with stakes and wire; and by planting seedlings, which may permit selection of more species. Planting fresh cuttings of willow in permanently moist soil, while the willows are dormant, has been successful, especially where muskrat, beaver and deer populations were not too high. Livestock should be excluded from areas of streambank vegetation except for watering places if wildlife enhancement and erosion control are prime objectives.

Roadside plantings: The performance standards for environmental protection of P.L. 95-87, Section 515(b)17, require that surface coal mining and reclamation operations "insure that the construction, maintenance, and postmining conditions of access roads into and across the site of operations will control or prevent erosion and siltation, pollution of water, damage to fish or wildlife or their habitat, on public or private property."

Careful selection of routes for haul roads will avoid much damage during construction. Planting the roadsides following construction will help control erosion and benefit wildlife. If roads are routed through timber, especially, the grass, legumes, and

Figure 39. Black locust. (Photo, U.S. Forest Service.)

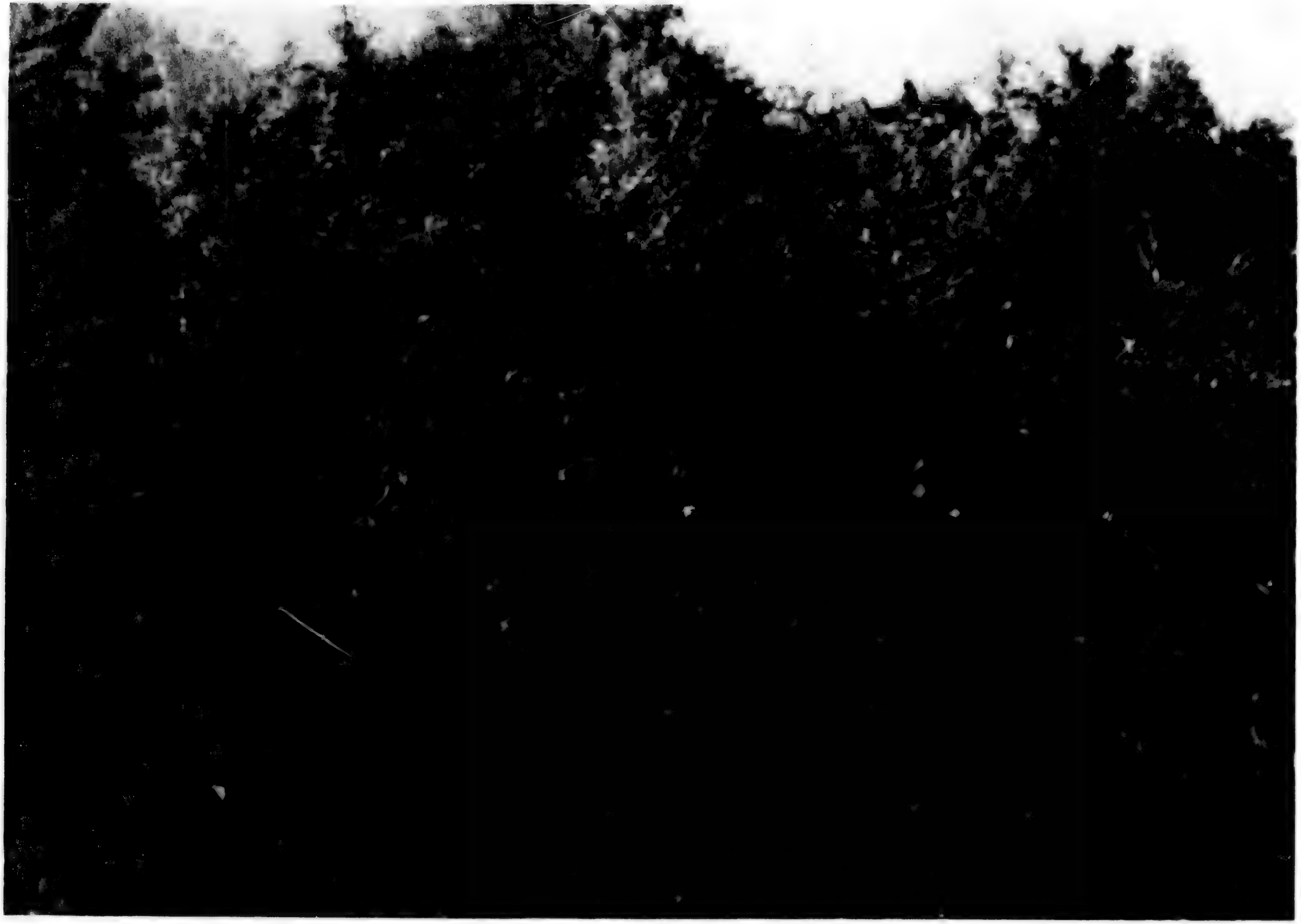

Figure 40. Bristly locust. (Photo, T.M. Franklin.)

Figure 41. Bulldozer striking off the crests of spoil banks. The area had been planted with black locust. The strike off created a flattened area and established diversity in habitats available to wildlife. (Photo, Southern Illinois University.)

Figure 42. A beaver swims back to his lodge in a small stream on reclaimed strip-mined land. Beaver thrive on reclaimed land—20 were transplanted to an erstwhile coal mine in Morgan County, Ohio, in 1958, and seven years later they had increased to more than 200. By 1967 they were numerous enough that the state began allowing annual trapping seasons. (Photo, National Coal Association.)

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shrubs which may be grown successfully on roadsides will provide edge-type cover valuable for nesting sites and for food. Some of the species suggested for possible use in roadside plantings are listed in Table 1. Usually it is desirable to plant a mixture of species. Similar treatment is appropriate for railroad spurs leading into a mine.

Under some circumstances it may be desirable to screen strip-mined areas from public roads. The most effective screens are composed of evergreen species. However, since some of the evergreens are slow-growing, it is often advantageous to plant a row of fast-growing trees or tall shrubs in the rear to give a quick summertime screen. Species appropriate for such screens may be selected from Table 1.

The manner in which roadside vegetation is maintained is important to wildlife. For example, roadside mowing should be delayed, if possible, until the nesting season is over. Much information on roads and wildlife, including vegetation management, is contained in *Highway-Wildlife Relationships* Vol. 1, *A State-of-the-Art Report*, and in a companion report, Vol. 2, *An Annotated Bibliography*. These volumes, prepared by the present authors, are available from the Federal Highway Administration, Office of Research and Development, Washington, D.C. 20590. They are also available from the National Technical Information Service, Springfield, Virginia 22161.

Travel lanes: Conditions for wildlife on surface-mined areas often can be improved by developing travel lanes. Such vegetated tracts, which need not be over a few feet wide, provide protected travel routes for wildlife. They afford wildlife on mined areas access to water, food, or cover, on or off the area, and they enable wildlife from adjacent areas to use needed habitat components on the mined area.

Travel lanes can be provided by planting one row of a dense-growing shrub such as bristly locust or Washington hawthorn or two rows of more open shrubs such as autumn olive, bicolor lespedeza, tatarian honeysuckle, or other shrubs such as are recommended in Table 1. Expenses and time permitting, a few extra rows of shrubs may be planted. Also, cover in the travel lanes is enhanced by the growth of some herbaceous plants alongside and between the shrubs. If the banks of diversion ditches are well vegetated, they serve as travel lanes, as do the strips of cover maintained under power lines leading into the mine area.

Field and woods borders: Field borders in areas reclaimed for agriculture serve the same functions as travel lanes for wildlife. Both field borders and woods borders create valuable edge cover. Using alternating rather than solid plantings of herbs, shrubs, or trees may be desirable. Although valuable for such species as squirrels, trees planted between fields devoted to row crop agriculture can result in reduced crop production because of shading; hence, herbaceous and low-growing shrubby plants would be more acceptable for such situations.

On surface-mined areas where extensive seedings of grass-legume mixtures have been made, the habitat can be diversified by planting a strip, not over 20 feet wide, of shrubs listed in Table 1. These may be planted at the edge of proposed pastures or cropland or across fields as hedges or living fences. One or two rows of shrubs selected from Table 1 and planted on the contour would benefit wildlife and perhaps aid in erosion control. When wildlife is assigned high priority, connecting these strips of shrubs with other clumps or blocks of vegetation within the grass-seeded area, or with permanent, undisturbed cover or impoundments, will be helpful.

Plantings between the edges of woods and cropland or pastureland help diversify the habitat. This is especially true if conifers and fruit-bearing shrubs are planted next to deciduous woods. In such a planting, two or three rows of pines with a single row of autumn olive, bayberry, rugosa rose or another appropriate shrub (Table 1) along the side closest to the field might be feasible.

Surface-mined sites as biological communities: In the last part of this report, the use of the approaches to vegetation management discussed here, and in preceding sections dealing with soil and water management, will be suggested for maintaining different kinds of biological communities on various types of surface-mined and immediately adjacent areas. For most sites use of a combination of several approaches to vegetation management is desirable.

Figure 43. Bulldozer creating a ledge around a box cut lake. A roadway was created which provided access to the lake for boats. This enabled people to get to the bank for fishing and nature observation. (Photo, Southern Illinois University.)

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Table 1

Suggested Plants for Use in Planting Patterns Beneficial to Wildlife

Beneficial to Wildlife as Hedgerows (H), Clump Plantings (C), Woodland-Field Borders (B), Stream Bank Plantings (S), Travel Lanes (T), Roadside Plantings (R), Windbreak (W)

Plant	Uses	Plant	Uses
	Shrubs		
Chokeberry	HS	Arrowwood viburnum	HCB
Japanese barberry	H	American cranberry bush	HS
Washington hawthorn	HCR	Buttonbush	CS
Autumn olive	HBTW	Silky dogwood	CBS
Japanese lespedeza	H	Gray dogwood	CB
Amur privet	HB	Natob bicolor lespedeza	CB
Amur honeysuckle	HS	Bicolor lespedeza	T
Tatarian honeysuckle	HCST	Fragrant sumac	C
Bayberry	HCSW	Smooth sumac	C
Multiflora rose	HCS	Arnot bristly locust	CTBH
Rugosa rose	HBW	Elaeagnus cherry	S
Buffaloberry	H	Japanese honeysuckle	S
Coral berry	HC	Crabapple (Toringo)	CR
	Herbaceous Plants		
Grasses		Leguminous Forbs	
Redtop	SR	Birdsfoot trefoil	SR
Perennial ryegrass	SR	Kura clover	S
Deertongue	S	Zig-zag clover	S
Reed canarygrass	S	Lathco flatpea	R
Kentucky bluegrass	SR	Weeping lovegrass	R
Red fescue	SR	Sweet clover	R
		Little bluestem	R
	Trees		
European black alder	S	Pin oak	S
Osage orange	SWBTR	Sawtooth oak	C
Tulip poplar	S	Willow	S
American sycamore	S	European larch	S
Yellow birch	S	Norway spruce	B
European white birch	S	White spruce	B
Gray birch	S	Red pine	CW
River birch	S	Austrian pine	CWR
White ash	S	Pitch pine	WCR
Green ash	S	White pine	WCR
Red maple	S	Scotch pine	WCR

Table 2

Nurse Trees and Shrubs

Trees	Shrubs
Black alder	Autumn olive
Black locust	Bicolor lespedeza
Silk tree	Arnot bristly locust
Gray birch	Indigobush
	Bayberry

Two Pennsylvania hunters are shown with evidence of good hunting to be found in reclaimed surface mining areas of central Pennsylvania. Spruce, pine and game food plantings which were begun some 15 to 20 years earlier make ideal game habitats of former surface mine areas in this part of the state. Turkey, deer and black bear abound in the area, which provides cover from trees of 25 to 30 feet high. Above, Jim McDowell of Morrisdale and George Holt of Hawk Run are shown with 17 and 18-pound wild turkeys shot on an open pit reforested plot near the Centre-Clearfield country line. The birds had been inhabiting the area where game food shrubs and red pines were planted. (Photo Pennsylvania Conservation Association.)

PART 4

Other Fish and Wildlife Management Activities

General

This part deals primarily with management measures and approaches other than those related directly to soil, water and living vegetation. Considerable attention was given to such approaches in the past, mostly on unmined land; now, however, some are rarely used and would appear to have little application to surface-mined areas generally. These include winter feeding, predator control, and wildlife refuges.

Artificial Feeding

Feeding of birds, especially in winter, is done extensively in urban and suburban areas and may help sustain—certainly it attracts—populations of birds in these areas. Winter feeding of wildlife on a remote and relatively inaccessible surface-mined area generally is impractical. However, if a landowner is willing to spend the time and effort to haul some ear corn to a site known to harbor bobwhite or pheasants, it might help some of these birds and perhaps other wildlife survive a prolonged period of ice and snow. Also, for areas used for recreation and wildlife viewing, winter feeding next to an access road can concentrate wildlife where it would be more visible to recreationists.

In the case of cold-water ponds, where the owner wishes to provide fishing through frequent stocking and rearing of trout to catchable size, feeding of commercially available pellets may be justified.

Predator Control

Predator control is often done with the thought that removal of one fox might mean several extra birds or rabbits left for the hunter, but research has shown that "nature" does not always work that way. Predator control might be feasible, assuming any legal restrictions were met, in special situations such as where intensive management was being done for the benefit of a preferred species, e.g., removal of larger turtles, which prey on ducklings, from a waterfowl production pond. Probably the best form of predator control for most species, however, on surface-mined sites is establishing and maintaining effective nesting and escape cover. Predators are a part of the ecosystem and are valuable in their own right, biologically and for hunting, trapping, and aesthetics.

Wildlife Refuges

Wildlife refuges are areas designated for the protection of wildlife and within which hunting is either prohibited or strictly controlled. Many strip-mined areas, because of their inaccessibility, difficult terrain for walking, and dense cover, do in fact serve as refuges for wildlife. This is true whether or not they are posted against trespass. By declaring them refuges or wildlife sanctuaries, however, and practicing some of the habitat management measures discussed above, one can preserve valuable habitat which will complement the wildlife habitat of adjacent areas. Also, they may provide opportunities for wildlife viewing, thus enhancing recreation values.

The measures discussed below have greater applicability as supplemental management approaches for surface-mined areas.

Regulation of Fishing and Hunting

Fishing and hunting regulations are designed to protect the resource, govern the manner in which fish and wildlife may be legally taken, and distribute the harvest among fishermen and hunters. Except for threatened and endangered species and most migratory birds, state laws apply to taking fish and wildlife on surface-mined areas. Private landowners have the right to post the land against trespass or to permit fishing and hunting.

On densely vegetated surface-mined areas with terrain difficult to hunt on, hunting will not normally reduce game populations below levels needed to sustain their numbers from year to year. Under some situations the problem may be to have enough deer removed, for example, to keep vegetation from being overbrowsed, thus reducing the carrying capacity of the area. With fish, in strip mine ponds, particularly, the problem is likely to be how to ensure adequate harvest of panfish such as bluegills and avoid overharvest of carnivorous or predatory fish such as bass and trout. Adjusting fishing regulations, if approved by the state fish and wildlife agencies, so that there are stricter limitations on removal of carnivorous species is one approach; encouraging panfishing derbies for youth groups is another.

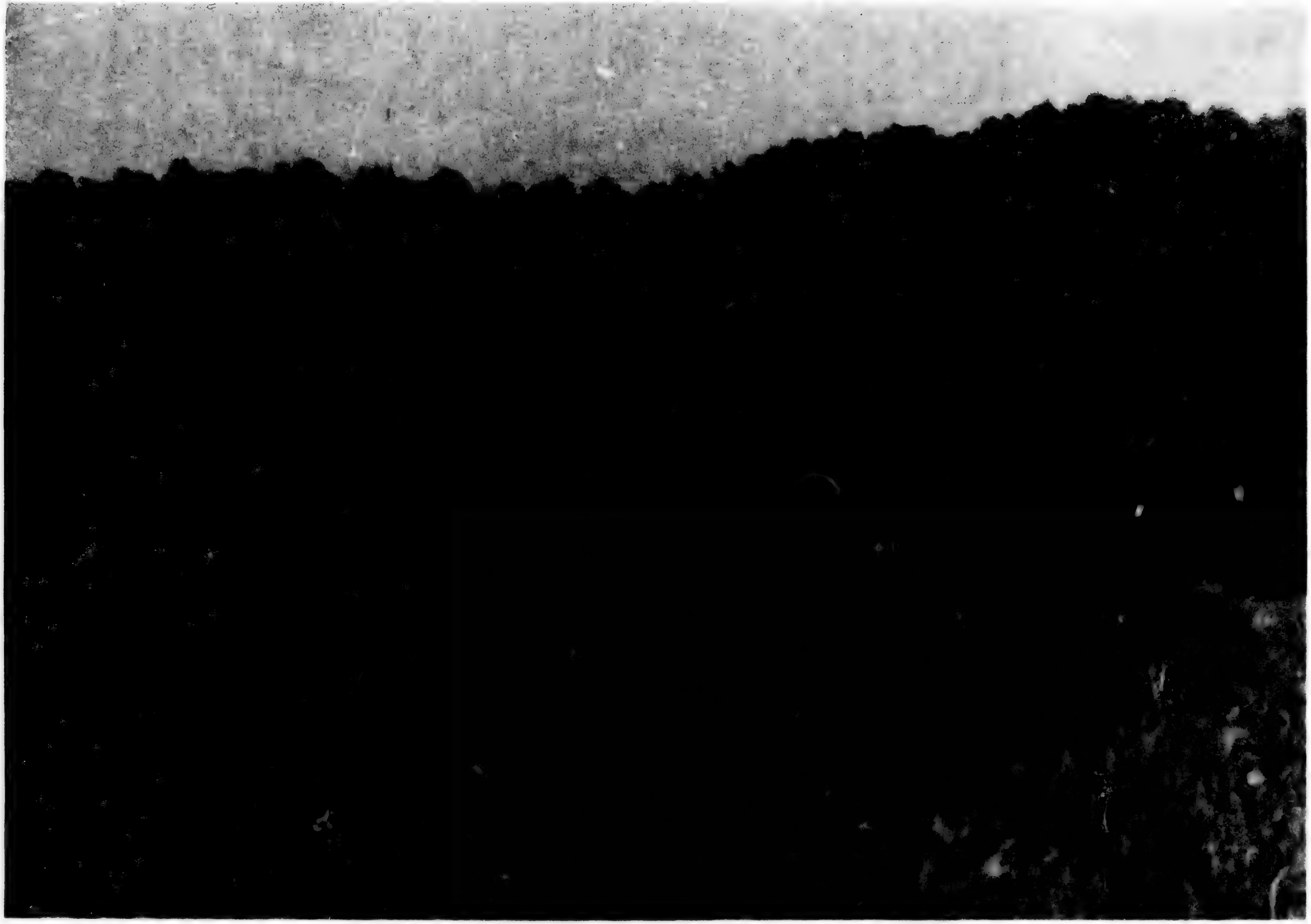

Figure 44. Clump planting of wildlife shrubs in eastern Tennessee. (Photo, T.M. Franklin.)

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Figure 45. Bird hunters and their dogs range over reclaimed strip-mined land near Rockport, Ky. This land, part of Peabody Coal Co.'s Ken mine, was mined in 1957 and planted in 1958. Lush grass and stands of pine provide food and cover for wildlife. (Photo, Peabody Coal Co.)

Other Management Measures for Wildlife

Nesting, resting, and cover devices

Mention has been made in connection with pond construction, or rehabilitation, of the possibility of creating earth islands valuable to wildlife within wet mine pits. When the water is too deep, or non-toxic spoil material is not available to create earth islands in ponds, floating rafts can be made and anchored so they remain near the centers of the ponds. These rafts improve open-water ponds lacking, as many strip mine ponds do, natural resting sites. The rafts can be made with scrap lumber or with a frame of 4" x 4"s or 2" x 2"s to which 1-inch boards are nailed. Boxlike rafts that hold soil and can be planted with grasses, rushes, and other suitable growth enhance conditions for nesting.

Floating logs in ponds are used not only by ducks for resting and preening, but also as perches by turtles, snakes and a variety of insects such as dragonflies. In water two to three feet deep, three bales of hay or straw, one bale placed cross-wise on top of two others, may be used as a base by muskrats for building a house. Ducks may use both the bales and the muskrat house as loafing sites.

Various kinds of nest boxes erected on surface-mined sites, especially those that have few trees with cavities available for tree-nesting or -denning wildlife, can improve the habitat for such species. Boxes for wood ducks are placed on posts in water, so the boxes are 4 to 5 feet above the expected high-water levels, or in trees adjacent to the pond 30 feet or more above the ground. In addition to wood ducks, hooded mergansers, goldeneye ducks, screech owls, tree swallows and great-crested flycatchers sometimes use wood duck nest boxes. Nesting boxes may be used, also, by saw-whet owls, sparrow hawks and bluebirds. Nest platforms or open structures in which nesting materials are provided are used by Canada geese.

As is shown by continuing studies at West Virginia University, in areas where there is a shortage of perches, the erection of perches with cross pieces 10 feet or so off the ground may result in increased hunting of rodents by red-tailed hawks and sparrow hawks or kestrels. Also, in areas that have been reclaimed as grassland, habitat for species like the eastern meadowlark and redwinged blackbird can be improved by placing smaller stakes at intervals as perching sites on the reclaimed mine site.

Tree squirrels cannot be expected to breed in strip-mined areas without trees. When trees on mined areas have reached the stage in which mast needed for food is produced, however, erection of squirrel nesting boxes can improve conditions for the gray squirrel and other species despite the lack of trees with natural cavities. Specifications for the construction of these nesting structures, often made of one-inch lumber, but sometimes of half of an automobile tire, usually can be obtained from the respective state fish and wildlife agency. Nesting structures are placed at a height of 20 feet or more and, in the case of wooden boxes, the entrance hole is about 2½ inches in diameter so squirrels, but not raccoons or other predators, can enter.

Logs, stumps, and limbs from timber cleared from a site in preparation for mining and placed in piles on unmined portions of the property can provide cover for cottontails and other species. If arranged in a sort of windrow with vegetation permitted to grow alongside, these piles may serve as wildlife travel lanes connecting habitat within the mined site to habitat off the mined area. Thus, the leftovers from timber that may have been harvested from a mine site can become valuable habitat for a variety of species ranging from bacterial decomposers, to fungi, wood-boring insects, amphibians, reptiles, birds, and mammals.

Similarly, rocks gathered from the surface of mine spoils and piled loosely in strategic locations, preferably near cover or food, can provide valuable cover for such species as ground squirrels, snakes and lizards.

Additional information on artificial assistance that can be given wildlife in the form of nest boxes and structures, floating islands and use of brush for shelter, along with many other suggestions for management, can be obtained from the book, *Practical Wildlife Management*, by George V. Burger (copyright, 1975) Winchester Press, New York.

Stocking

Usually it is not necessary to release or stock birds, mammals, or other wildlife on a surface-mined area. When conditions are suitable, those species which can survive on the area will move in from nearby. Stocking of a species like the beaver, however, on an area where water and food in the form of willow, cottonwood or other trees known to be used by this species exist, may hasten its establishment. Release of exotic species—those imported from other countries—or native species from other parts of the United States is not recommended. The importation and release, in any case, of exotic species must be approved by the state and the U.S. Fish and Wildlife Service.

Fencing

Usually ponds in surface-mined areas reclaimed for livestock are more valuable to wildlife if they are fenced. If the fences can be kept 25–30 feet from the pond edge, the protected strip of vegetation within the

Figure 46. Reclamation of strip-mined land bears a bonus of recreation. This lake was created at Peabody Coal Co.'s Broken Aro mine near Coshocton, Ohio. The land was reclaimed after mining and, under Peabody's "Green Earth" program, the lake was stocked with fish. (Photo, Peabody Coal Co.)

Figure 47. A Giant Canada Goose—a subspecies which may weigh as much as 20 pounds—examines her newly-hatched goslings in a nest on reclaimed strip-mined land in Illinois. Coal companies and state wildlife biologists worked together to restock the area with this bird, once thought to be extinct. (Photo, National Coal Association.)

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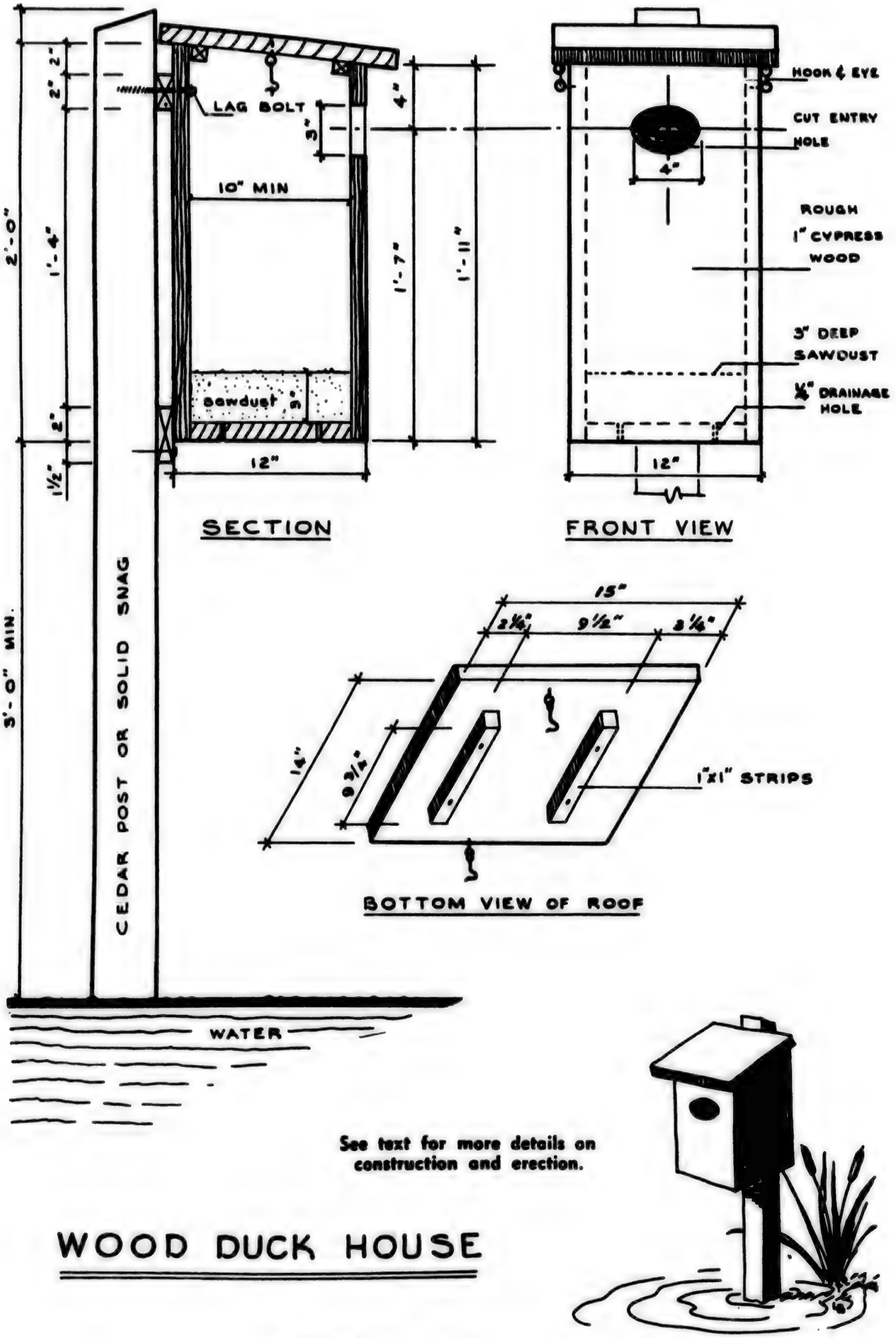

Figure 48. Construction of wood duck house.

Figure 49. Feeders may be operated in fall, winter, and early spring in areas devoid of good seed producing plants. Feeders may contribute importantly to a variety of birds and small mammals. (Photo, Southern Illinois University.)

fenced area provides safer nesting cover for ducks and other birds, and pond bank erosion caused by the trampling of livestock will be prevented. In some situations it may be feasible to fence off only a part of the pond, permitting access of livestock to the remainder for water.

Other Management Measures for Fish

For fish production some mention has been made of the need of maintaining water pH of 6 or above and possible ways of improving spawning bed conditions and providing cover. Additional details and other suggestions will be given here.

Liming and fertilizing to improve water quality

In the case of existing surface mine ponds, if the pH is low, lime should be added to increase the water's buffering capacity. For new impoundments where the pH may be less than 5.5, the bottom soils should be limed enough to increase the pH to 7, and, after the pond is filled, water should be checked for adequate pH. If the pH is less than 6, finely ground agricultural limestone should be evenly distributed at the rate of 800 to 1,000 pounds per acre. More lime should be added at weekly intervals until the water tests 6.5 or higher and thereafter, monthly checks should be made and lime added whenever the pH falls below 6.

Most surface mine ponds are low in natural fertility, at least initially, and although they will support fish if the pH is above 5.5, the growth rate of such fish is slow. Stunted fish often are common in such cases. Fertilization, which may be required frequently, increases production of fish and fish food organisms, and aids in the control of submerged waterweeds. Farmers' Bulletin 2250, *Warmwater Ponds*, available at local SCS offices, provides information on types of fertilizer and rates and time of application.

Fertilizing is generally done during the growing season of microscopic algae from spring to fall. A fertilizer designated as 8-8-2 has 8 pounds of nitrogen, 8 pounds of phosphorus and 2 pounds of potash per 100 pounds of fertilizer. Stronger fertilizers such as 10-10-5 or 12-12-4 may be used as long as they contain as much nitrogen as phosphorus. The fertilizer can be poured from a boat or broadcast by hand from the banks of small ponds. Infertile ponds may require as much as 1,200 to 1,600 pounds per acre per year, but no more than 200 pounds per acre should be applied at any one time. Fertile water is greenish or brownish.

Lime neutralization structures have met with limited success in treating acidic streams and may result in the formation of floc injurious to fish food habitat on the stream bottom. Sudden acid discharges or the temporary shutdown of neutralization through this approach are costly and temporary. The cure for the problem is at the point of origin, i.e., better treatment of the watershed so there is no acid mine drainage.

Stocking and maintaining favorable species balance

Ponds newly developed in the reclamation of surface-mined lands require stocking. This is not a matter of dumping an assortment of fish caught in nearby ponds or streams into the new pond indiscriminately, but requires consideration of water temperature, fertility and other factors discussed earlier. Often in warmwater ponds of average fertility the stocking rate for bass and bluegills is 50 bass and 500 bluegills. Information on stocking bass and bluegills and on other combinations of fish species is available from the Soil Conservation Service and from the U.S. Fish and Wildlife Service, Branch of Fishery Assistance, Princeton, Indiana 47670.

As has been noted, redear sunfish, redbreast sunfish, and channel catfish are found in some surface mine ponds. The two sunfishes may be substituted for or complement bluegill populations. The channel catfish, a predatory species, does not reproduce in ponds, but can be used in warmer areas to help control sunfish populations. Also, the fathead minnow or the golden shiner, often referred to as baitfishes, may be included in the stocking program to consume the minute plant organisms or phytoplankton in the water and provide food for other fish in the pond. Thus, a combination of largemouth bass, bluegill and/or redear and redbreast sunfish, channel catfish, and a baitfish will most effectively use the natural foods available in the ponds, thereby maximizing production.

There may be problems of fish species composition imbalance and of overharvest of largemouth bass in small impoundments on surface-mined areas, as in other ponds. In existing ponds with unbalanced populations, or ponds full of stunted or undesired fish, it may be feasible to kill the fish and start again with stocking. The owner should consult with the state fish and wildlife agency regarding any state laws governing the use of fish poisons and for information on fish poisoning methods. Information on fish control through safe use of toxicants can be obtained from the Fish Control Laboratories, U.S. Department of the Interior, Fish and Wildlife Service, P.O. Box 862, LaCross, Wisconsin 54601.

Surface mine ponds fed by cool springs or small streams which never exceed 70 degrees F may be suitable for trout production but reproduction in ponds is uncommon; hence, trout—usually rainbow or brook—are stocked repeatedly. Trout may be stocked as advanced fry (one to two inches long) or fingerlings

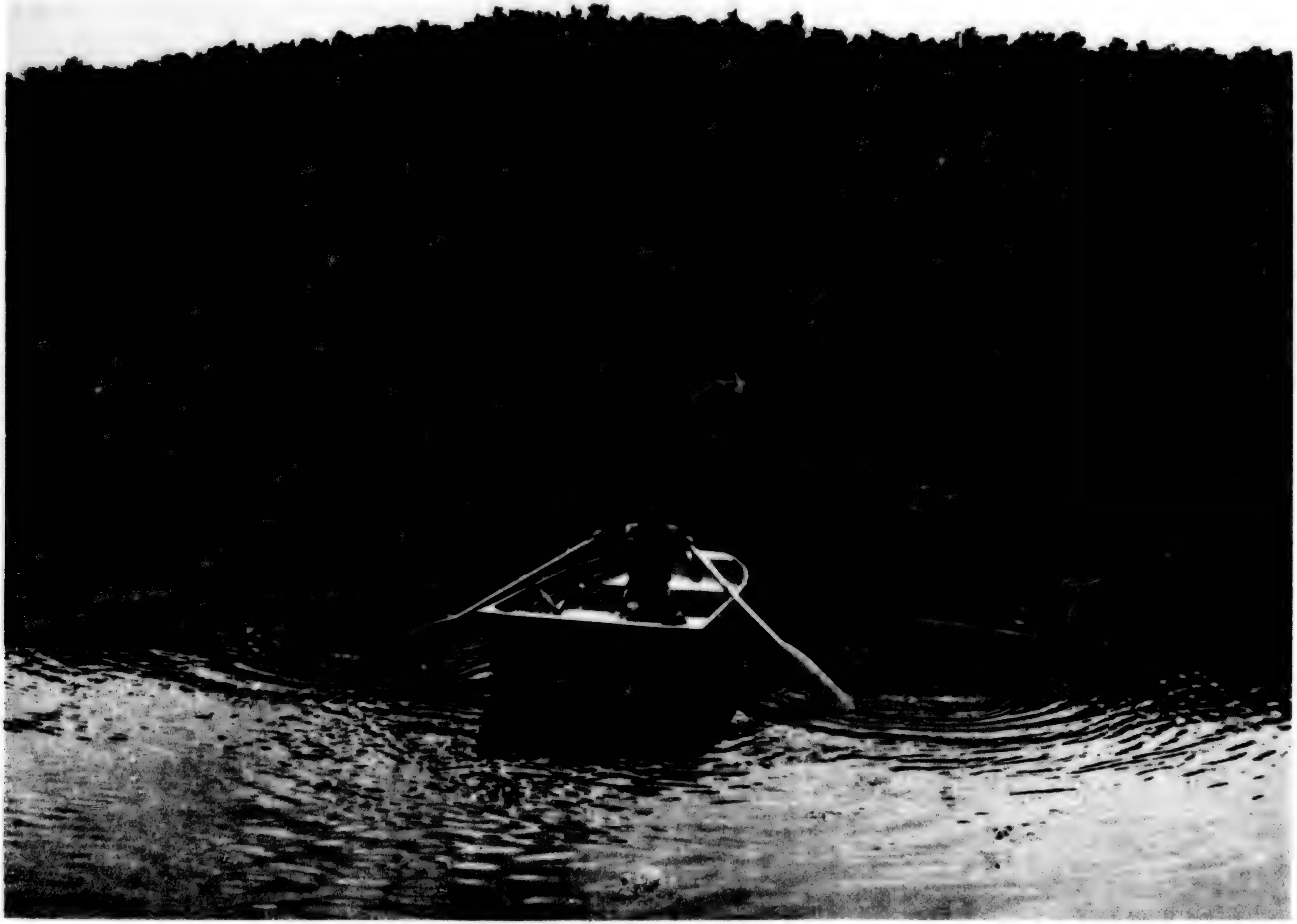

Figure 50. This young man is boating on a lake formed when the final cut of a strip mine was filled with water. Land reclamation programs have created hundreds of such lakes. (Photo, National Coal Association.)

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(two to four inches) and allowed to grow to harvestable size or stocked as eating-size trout and harvested on a put and take basis. Farmers' Bulletin 2249 entitled *Trout Ponds for Recreation,* available at local SCS offices, provides much valuable information.

Stocking of streams usually is unnecessary because coolwater fish species such as smallmouth bass, rockbass, and walleye, unless completely eliminated from the stream, will invade those sections affected by mining when conditions permit. Trout may be absent from some streams only because they are unable to reproduce. In situations of this kind where self-sustaining populations of trout do not exist, fingerlings may be stocked and allowed to grow to a catchable size in the stream. Also, if the demand for trout fishing is sufficient to warrant the expense, a stream normally too warm for trout in the summer may be suitable for spring stocking with trout large enough to be harvested before the summer warmup.

Information on the availability of fish for stocking can be obtained from the state fish and wildlife agency or the local SCS office. Information sources are given in Appendix D of this publication.

Cover for fish

As with terrestrial wildlife on mined sites, fish habitat can be improved by use of some of the brush removed prior to mining for underwater cover. Limbs or small trees carefully secured to stumps or trees along the banks of small streams provide resting places and shelter for fish. In northern areas brush and log shelters can be constructed, weighted and placed on frozen surface mine lakes in locations where, when the ice melts, they will fall into 10-15 feet of water. More information on cover development is included in the USDA Forest Service's *Wildlife Habitat Improvement Handbook* (1969).

Spawning beds and structures

In ponds or lakes with bottoms unsatisfactory for fish spawning, introducing gravel or crushed stone and installation of various types of artificial spawning structures may improve natural spawning beds. The natural reproduction of some large catfish apparently can be encouraged by installing drain or flue tiles in new reservoirs before filling the impoundment. The tiles, with one end filled with concrete, should be laid almost horizontally in a small trench on the lake bottom three to five feet below the conservation pool level where they can serve as holes in which catfish may spawn. (See the USDA Forest Service's *Wildlife Habitat Improvement Handbook,* 1969.)

Evaluating Management Success

An integral part of planning and management is periodically evaluating management measures to determine whether or not program objectives are being achieved. Thus, if the management or reclamation plan called for maintaining a pH of 6 in a newly created impoundment where the pH of the water was 4.5 initially and raised to 6.5 by liming, the manager would need to make frequent tests and add lime as necessary. With respect to vegetation, P.L. 95-87 requires the owner-operator to establish permanent vegetative cover and to assume responsibility for successful revegetation for a period of five full years after the last year of augmented seeding, fertilizing, irrigation, or other work required in the initial establishment of vegetation. If, for example, plantings failed because of soil acidity, it would be necessary to make additional plantings or perhaps use more soil amendments, prepare a better seedbed, and then reseed.

In any case, the wildlife manager will wish to determine the effectiveness of various management measures applied. This will require fish and wildlife inventories so comparisons can be made with premanagement inventories, checking the use of food plots to determine if the food was consumed or wasted because the plots were too large, and making other inspections of this nature. On the basis of these evaluations, the management plan can be updated to make management more effective.

This series of photographs depicts wildlife habitat development on surface-mined area over a 15-year period in eastern Kentucky. Photos, U.S. Forest Service.

PART 5

Examples of Fish and Wildlife Management on Surface-Mined Eastern Coal Lands

PURPOSE AND SCOPE

This part illustrates, through sketches and descriptive notes, some of the management approaches suggested in the previous sections of this volume. Examples based on both real-life and hypothetical situations are presented to show what can be done to enhance fish and wildlife in different geographic and land use areas of the eastern United States following surface mining of different types. They involve impoundments, streams, wetlands, and dry, upland sites. Some individual fish and wildlife species are mentioned as benefiting from various kinds of suggested management. However, the emphasis is on management of habitat for groups of species or biologic communities in relation to the primary postmining land use indicated for the area. This usually includes both the mined site and the adjacent habitat. The illustrations provided should enable the reader to visualize how an area will look following different management procedures and over varying periods of time. Discussions of vegetation management, including various types of plantings for road- and stream-sides, and woods and field borders; pond construction; nesting, perching, and cover structures; and other approaches to fish and wildlife habitat management, referred to in the legends of these sketches, are given in Parts 3 and 4 of this volume along with additional illustrations.

EXAMPLE 1

Example 1. Area Method of Surface Mining as in Illinois

In this example, part of which is based upon an aerial photograph taken by the senior author southeast of St. Louis, the land is relatively flat and devoted primarily to the production of soybeans and corn.

Sketch A shows an area along a stream in the lower lefthand corner that was mined years ago and, through plantings and natural plant succession, is now forested. An impoundment (a) created by strip mining is located in the wooded area. The drainage ditches shown have little vegetative cover along the banks.

Sketch B, patterned after the aerial photo, shows the same area with mining done in recent years in the upper central portion where there is a sizable last-cut impoundment (b), which we shall assume is nonacidic, and where there is only sparse vegetation on the spoil ridges. At the lower central portion of the sketch, mining is being done currently with newer methods. Note that the topsoil has been removed and piled separately from the spoil and there is a sediment pond. In another impoundment (c) the shoreline has been left gently sloping in mining. A short new haul road connects with the previous haul road. Some of the ground adjacent to the haul roads, and subject to future mining, has been left fallow.

Sketch C depicts some of the management measures that can be taken to enhance fish and wildlife.

1. Wood duck nest boxes are installed around impoundment (a) in the oldest and wooded mined tract.
2. Openings are created in the woods to encourage growth of shrubs and herbaceous plants. Lespedezas are seeded in parts of these openings.
3. Plantings are made along the woods border and the drainage ditches to diversify cover and serve as wildlife travel lanes.
4. A strip of corn is left uncut along the edge of the recently mined tract to provide wildlife food.
5. Spoil banks are flattened along the last-cut impoundment (b) to permit easier access to the pond for fishing.
6. Portions of some of the other spoil ridges of the recently mined area are flattened and sown with lespedeza or used for wildlife food plots.
7. Around impoundment (c) in the most recently mined tract, aquatic vegetation is encouraged along the gently sloping banks and native prairie grasses are being established on the adjacent area. This pond is managed for waterfowl, shorebirds, and other wildlife, whereas impoundment (b), with steep shorelines, is managed for fish.
8. On the most recently mined area, the spoil is leveled and graded to approximately the original contour, the topsoil is replaced, and the area is returned to agricultural use, but with wildlife benefits such as are provided by field borders.
9. In the area left fallow near the haul roads, disking on a rotation basis stimulates the growth of herbaceous plants valuable as food for wildlife.

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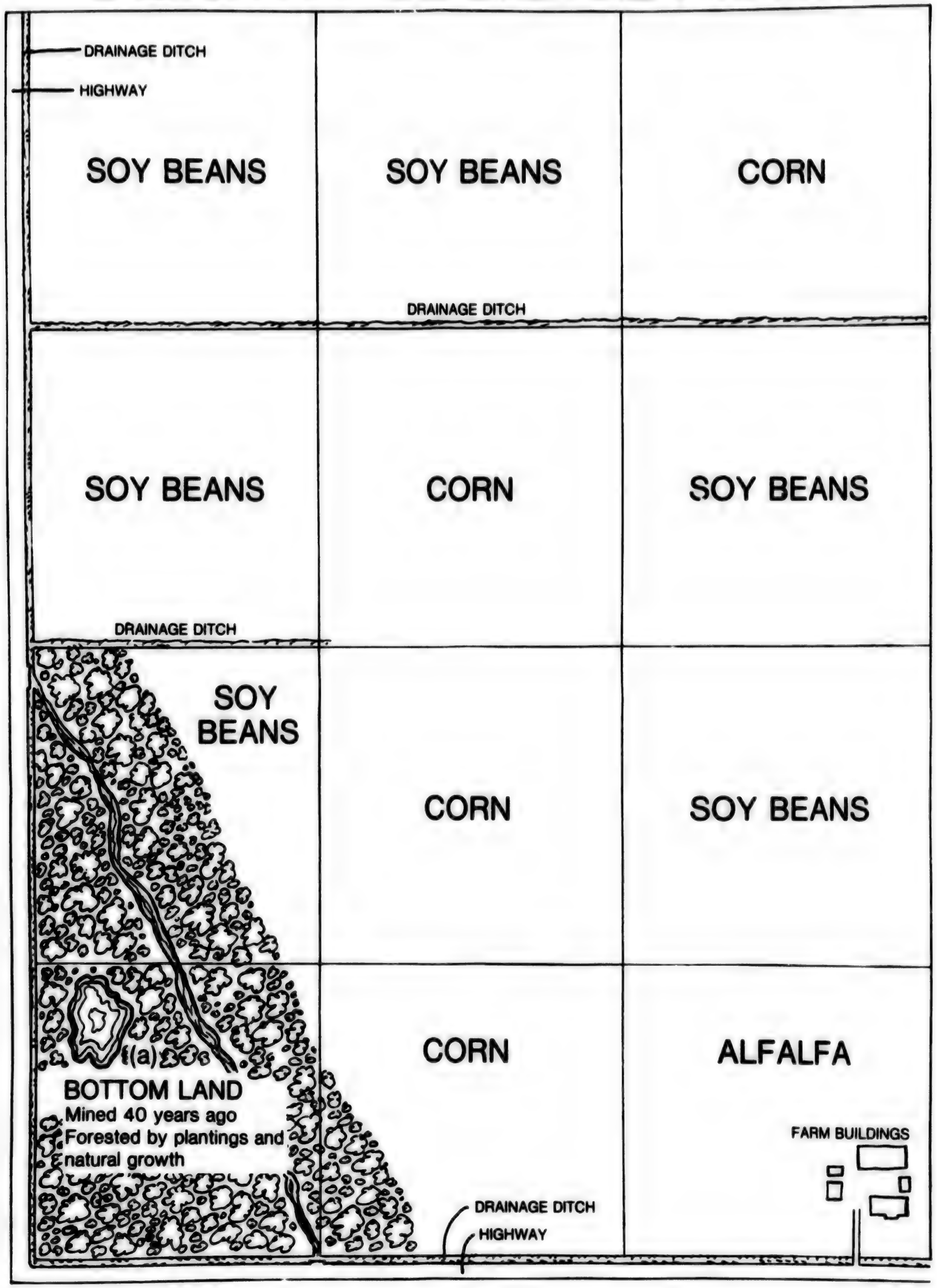
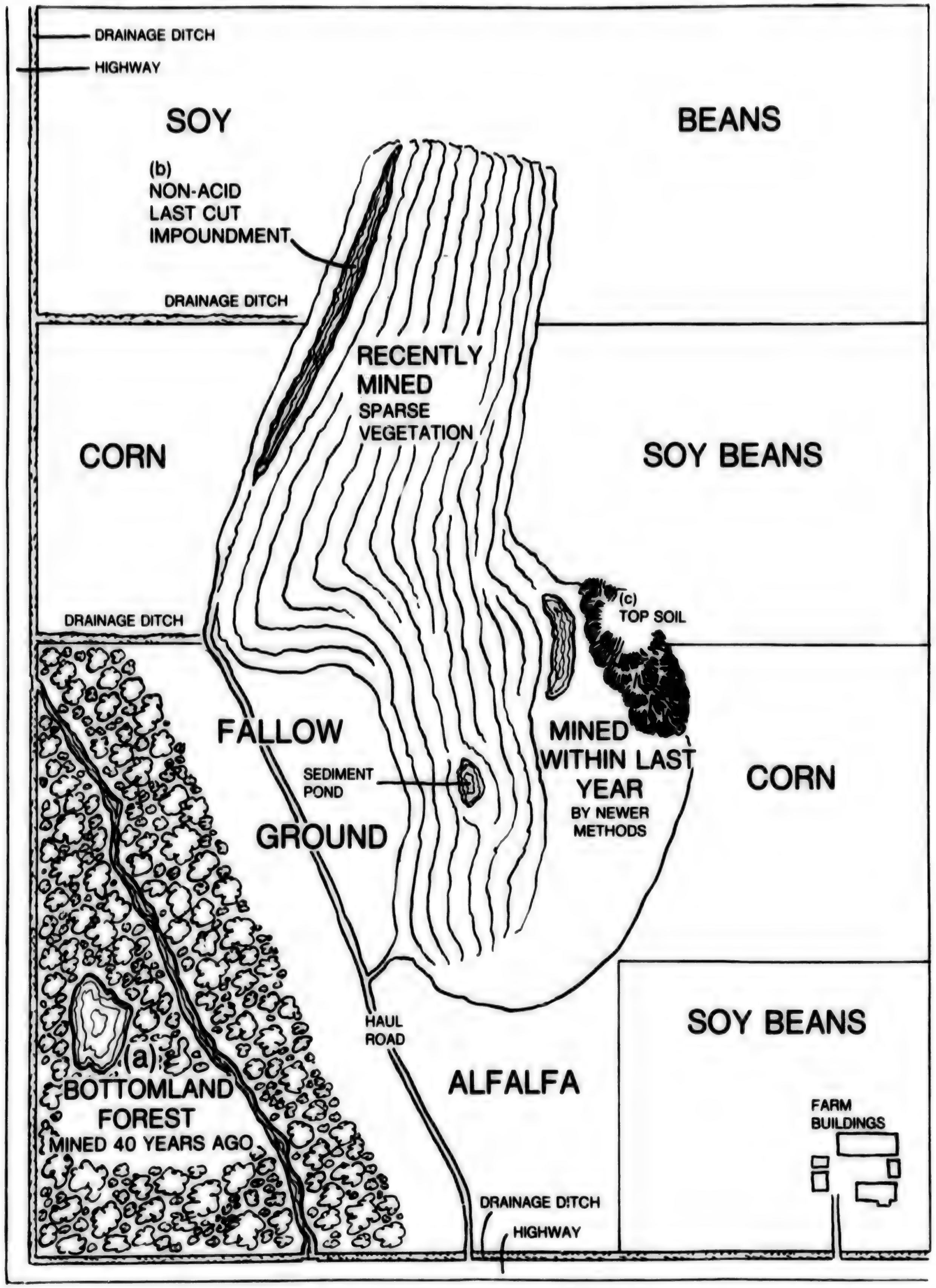
SKETCH A — BEFORE AREA MINING

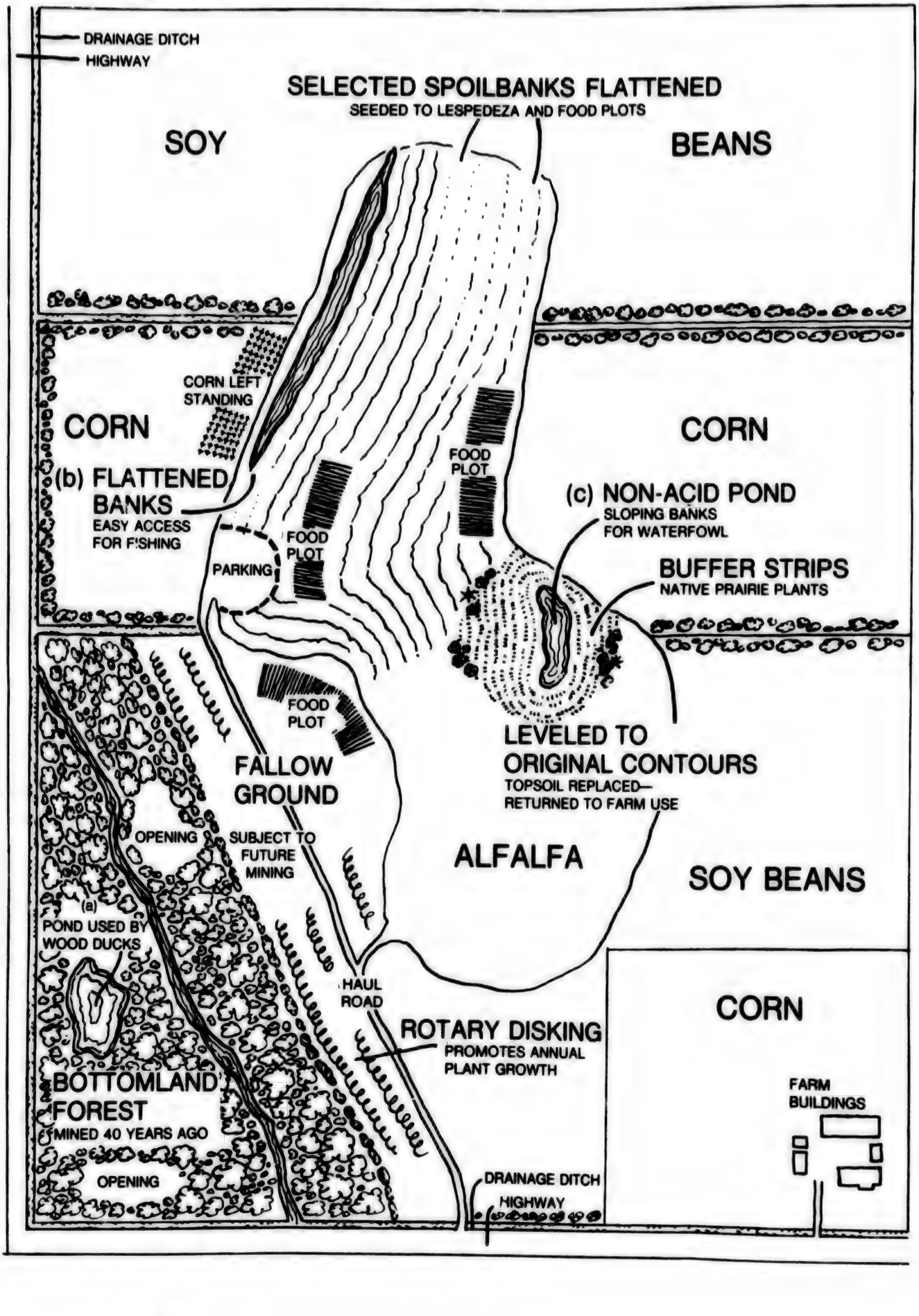


SKETCH B — DURING AREA MINING



Example 1. Area Method of Surface Mining as in Illinois

SKETCH C — RECLAIMED AREA MINE



EXAMPLE 2

Example 2. Contour Mining as in East Tennessee

This series of three sketches depicts a situation such as might be found in East Tennessee or elsewhere in Appalachia.

Sketch A shows a stream and its tributaries paralleled by a township road running through a forested valley, with lowland forest grading into upland forest. The unique spring-biologic area in the upland forest is worthy of preservation during the mining.

Sketch B depicts the situation during mining. The unique area is preserved. The outslope of the contour mine is seeded to grass for quick stabilization. Soil erosion and sedimentation control measures include diversion ditches and sediment ponds. Topsoil is separated from the spoil and stored for later use, and remnants of timber and brush removed from the site are piled at the edge of the mined area.

Sketch C, beginning at the top and proceeding to the bottom, depicts the following fish and wildlife management measures:

1. The mined area is regraded to conform approximately with the original contour; topsoil is redistributed and seeded with a grass-legume mixture.
2. A food plot is established at the upper end of the reclaimed area next to the original woods.
3. Conifers and shrubs are planted on the reclaimed site to provide habitat diversity, both along the edges of the undisturbed forest and in clumps within the area seeded to grasses and legumes.
4. The diversion ditches and borders are seeded and planted with shrubs to serve as travel lanes for wildlife.
5. The impoundment created by mining is maintained with the special exception provided in P.L. 95–87, as are the sediment ponds.
6. Alder is seeded in low, moist areas along the stream to benefit woodcock and other wildlife.
7. Wood duck nesting boxes are installed along the stream and original wetland area.
8. An opening is created in the upland forest to promote growth of herbaceous plants, shrubs, and seedlings. Part of the opening is seeded to legumes.
9. Some of the brush is removed from the original disposal site and arranged strategically within and along the borders of the reclaimed site for wildlife cover.
10. A small impoundment, with contours designed for fish management, is created under special provisions of P.L. 95–87.
11. Streamside plantings are made to stabilize the stream banks and improve conditions for fish and wildlife.
12. The haul road, not contributing to erosion or pollution, is retained for access to the area. Shrub plantings along its sides provide additional diversity to the wooded area it traverses.

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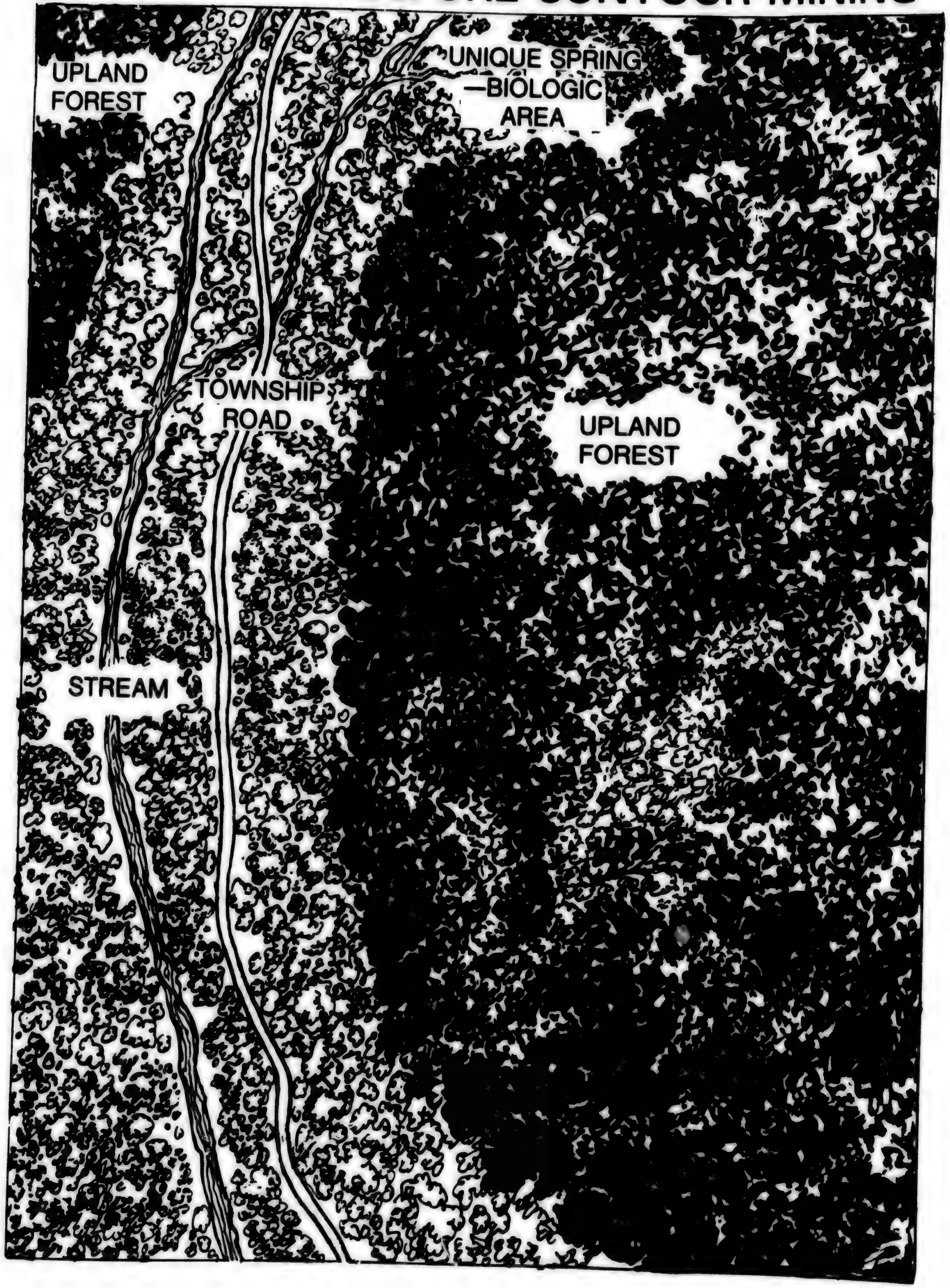
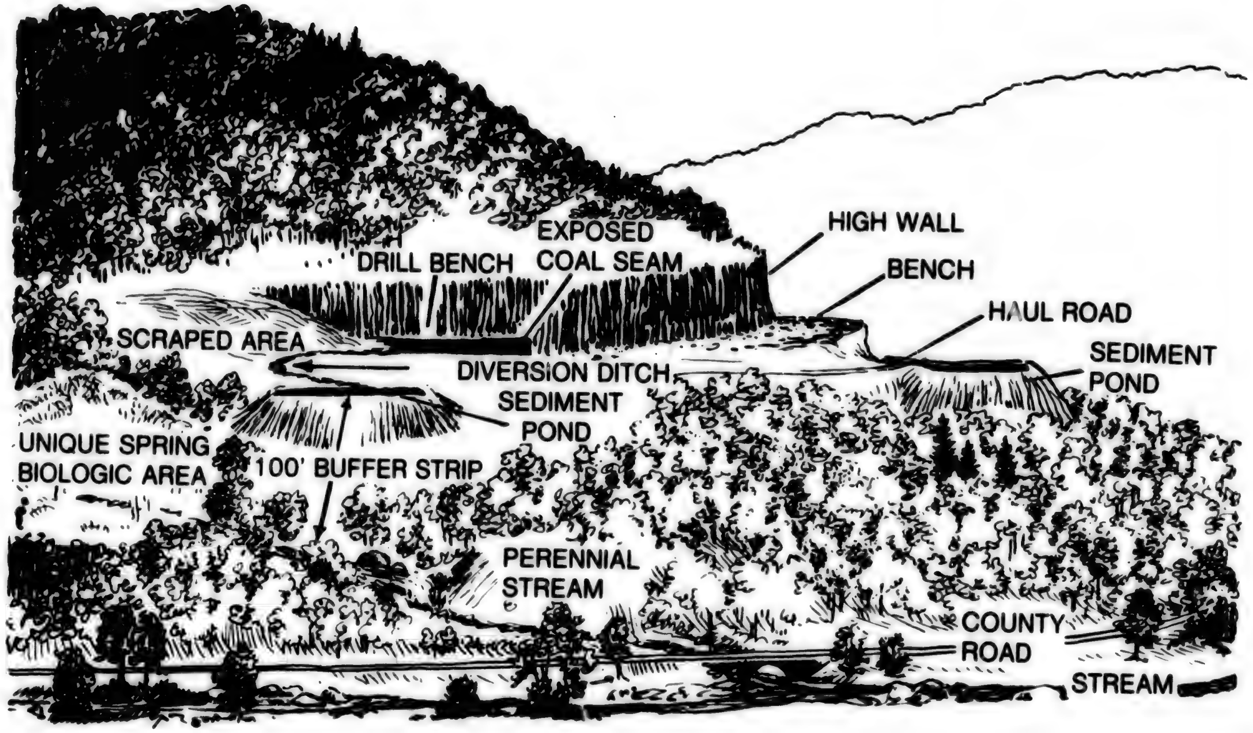
SKETCH A — BEFORE CONTOUR MINING

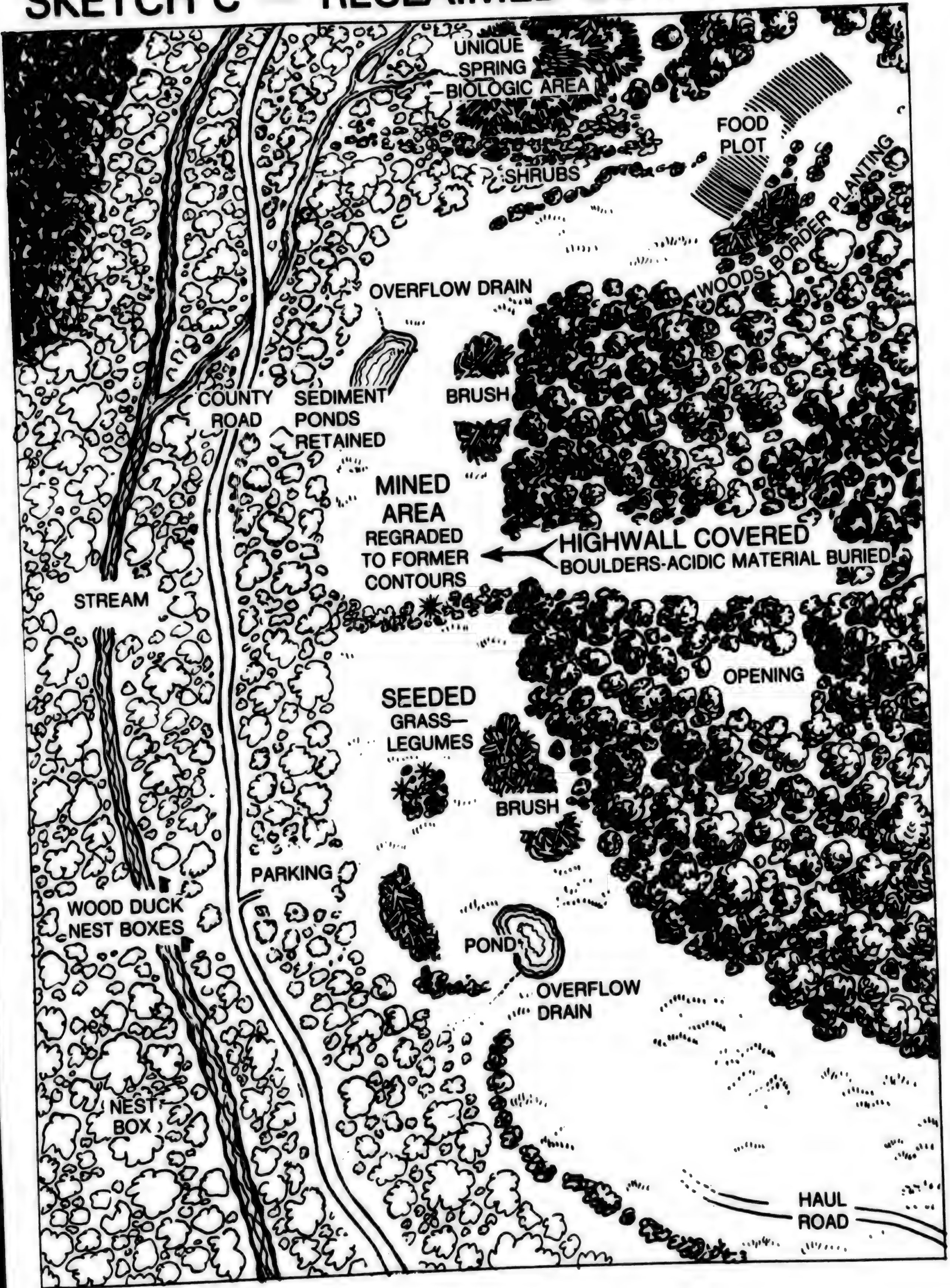


SKETCH B — DURING CONTOUR MINING



Example 2. Contour Mining as in East Tennessee

SKETCH C — RECLAIMED CONTOUR MINE



EXAMPLE 3

Example 3. Mountaintop Removal Method as Practiced in West Virginia

This series of sketches depicts a hypothetical situation, becoming more common with modern mining equipment and methods, whereby entire mountaintops are removed in the extraction of coal.

Sketch A shows a forested, rounded mountain with steep slopes and hollows. A stream is depicted flowing along the base of the mountain to be mined, and a county road separates the stream from the mined area. Regardless, a 100 ft. buffer zone exists between the mined area and stream.

Sketch B shows, with mining partially completed, a plateau where the original mountaintop existed. Although topsoil is piled at the lower end of the mined site, most of the overburden is hauled into the head of the hollow. The hollow is filled and terraced and a rock core is installed for drainage. A sediment pond is constructed below the toe of fill to protect the stream. Care is taken to avoid unique biological communities. Brush and limbs remaining from the clearing of timber are stacked at the edge of the mined site. Through seeding of the spoils material and structural means, accelerated erosion is prevented. The haul road is sited to avoid, as much as possible, undesirable impacts on the stream. Streamside vegetation is retained as a buffer against erosion and pollution.

Sketch C shows steps taken to enhance conditions for wildlife during reclamation of the mining site.

1. The top soil is redistributed on the plateau-like land form remaining after mining.
2. The plateau is seeded to grass and legumes.
3. Brush is piled at strategic locations around the perimeter of the mined area and next to the wooded area to provide cover for wildlife.
4. Clump plantings of shrubs and conifers are within the grass-legume seeded plateau (not being used for either hay or pasture) and on the head-of-hollow fill.
5. Border or strip plantings of shrubs and conifers are around the perimeter of the disturbed site next to the woods and in some cases across the seeded area to provide diversity and travel lanes for wildlife.
6. A permanent impoundment meeting requirements of P.L. 95–87 is created on the plateau. This provides habitat for fish, and water necessary for wildlife populations.
7. Bird perches are installed in the grass- and legume-covered plateau to increase its use.
8. Plantings are made along sections of the reclaimed hollow in need of vegetative cover.
9. Openings are created in densely forested areas to encourage growth of herbaceous plants and shrubs.
10. Plantings are made along the haul road, retained for access to the area, in order to diversify the habitat and control any erosion caused by the road.

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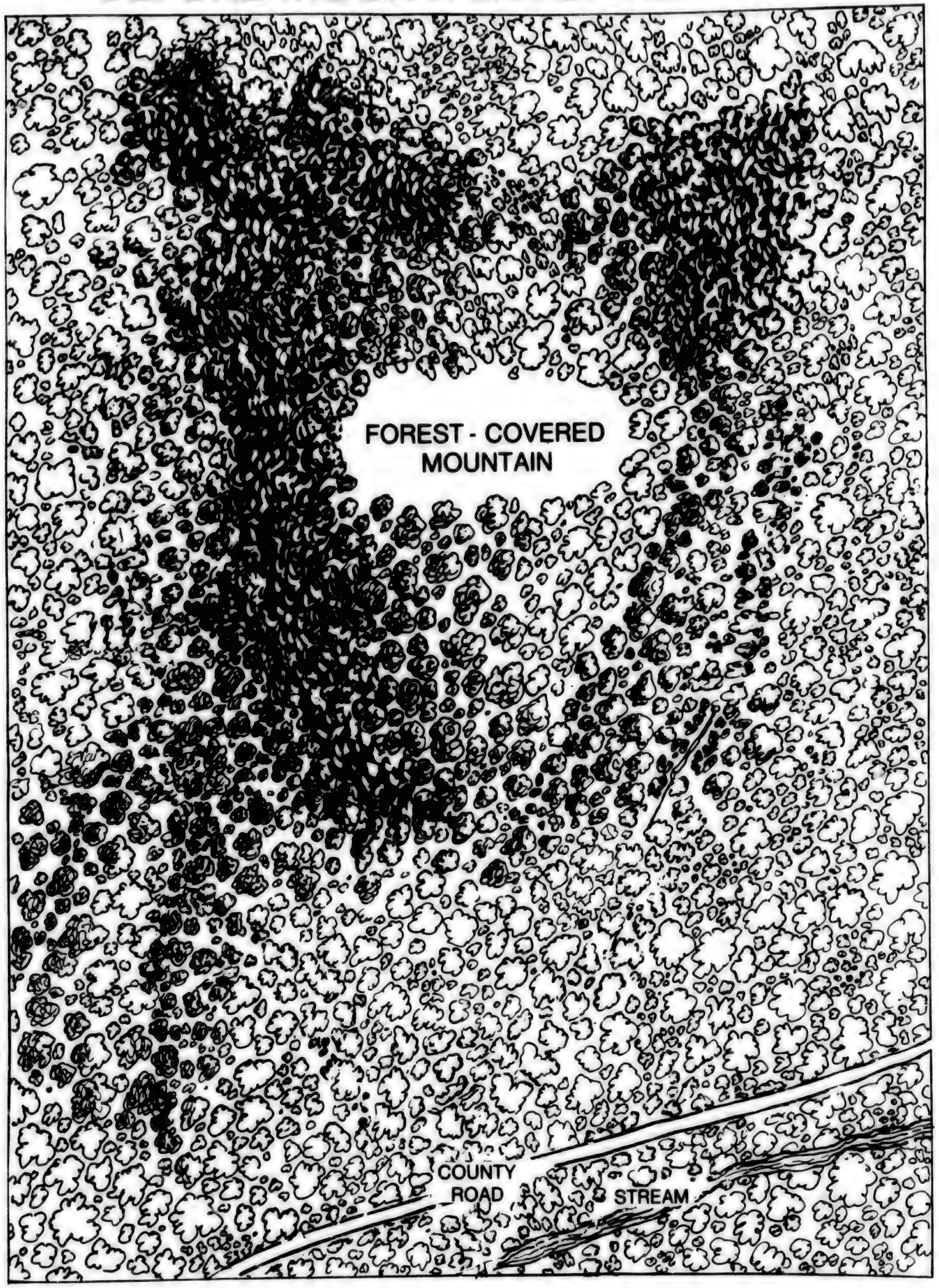
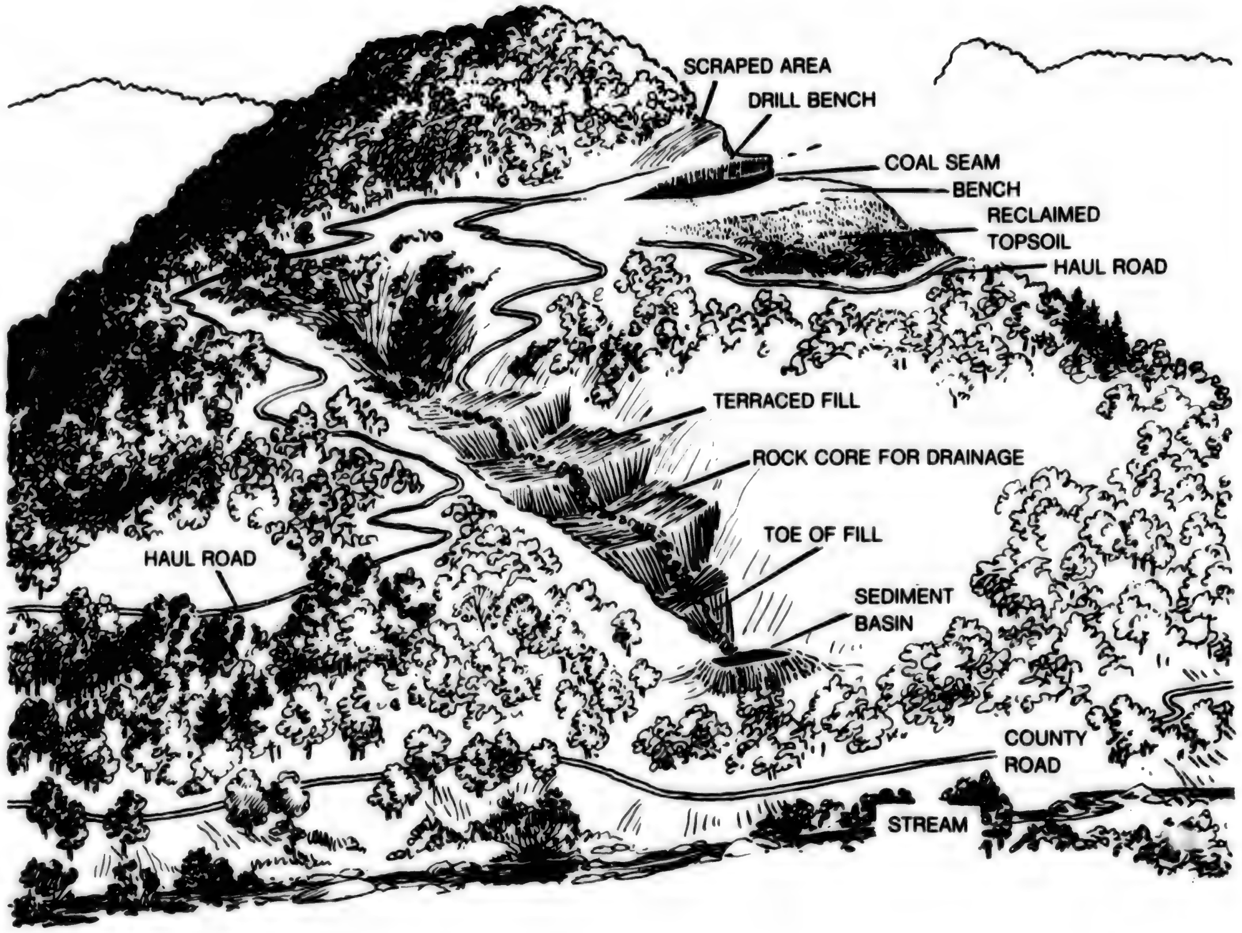
SKETCH A — BEFORE MOUNTAINTOP REMOVAL

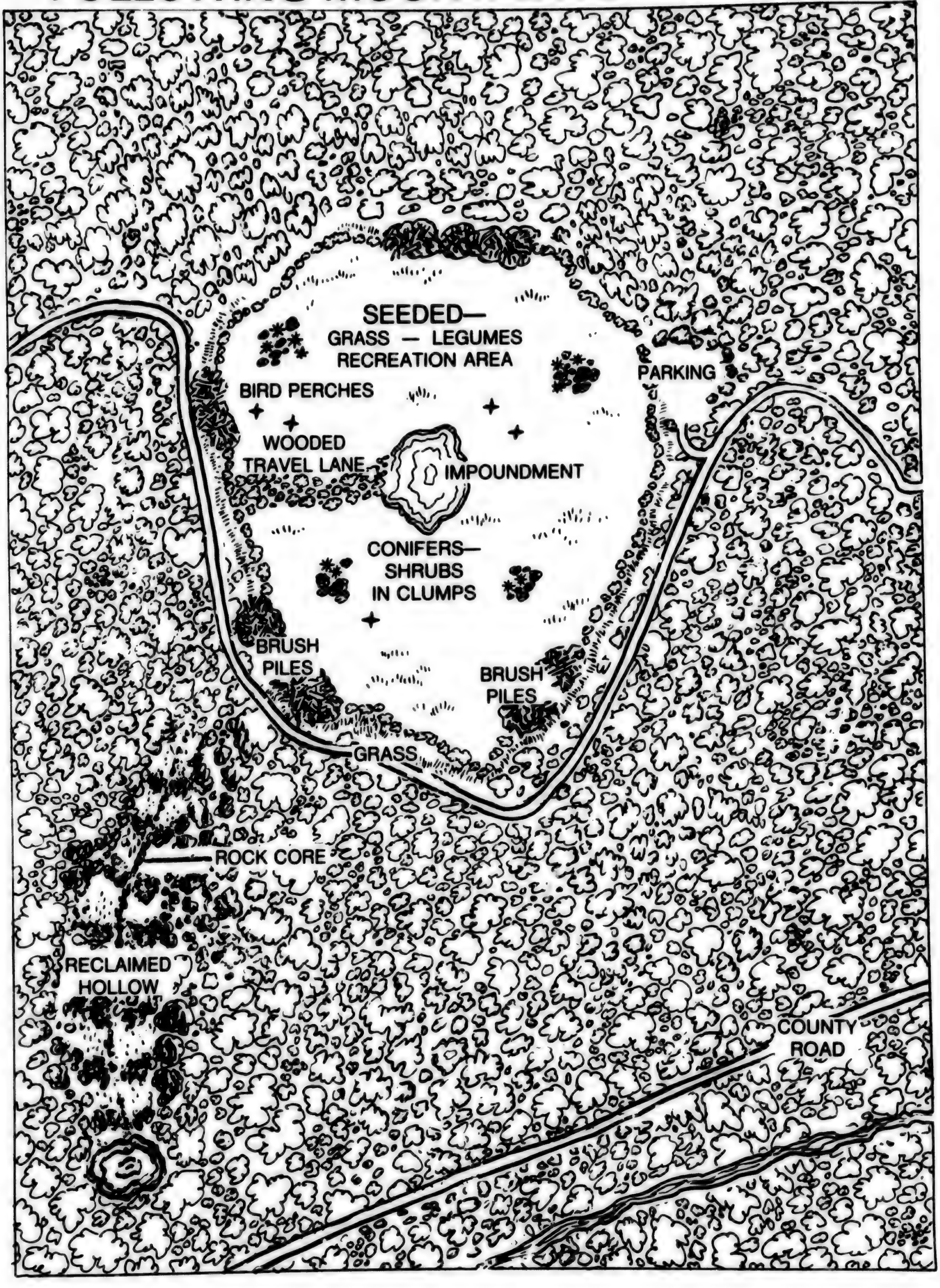


SKETCH B — MOUNTAINTOP REMOVAL METHOD DURING MINING



Example 3. Mountaintop Removal Method as Practiced in West Virginia

SKETCH C — AREA RECLAIMED FOLLOWING MOUNTAINTOP REMOVAL



VOLUME II
APPENDICES

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Appendix A.

U. S. DEPARTMENT OF AGRICULTURE Soil Conservation Service **WORKSHEET DETERMINING PRIORITY AND MAIN BENEFITS** SCS-CO-157 (10-78)	NAME OF APPLICANT	ELIGIBLE ACRES
	PRIORITY	MAIN BENEFITS *(Offsite or Onsite)*

INSTRUCTIONS: Highest priority checked prevails for entire acreage. Enter in the Acres column the number of eligible acres that **must be treated to correct the problem or to achieve the benefit described. Acreage total cannot exceed the total eligible acreage.** Always start at the top and work down. Include acres of hazard plus interdependent acres that would require treatment to obtain benefits identified or solve problem described. Compare recorded information in Part A to that recorded in Part B. If the benefits and/or acreage recorded in A is more than B, main benefits are offsite. If B is more than A, main benefits are onsite. **NOTE: Priority 1 and 2 reclamation should always have the main benefits offsite.**

PRIOR-ITY	BENEFITS	CHECK *(If applicable)*	ACRES NEEDING TREATMENT	DESCRIPTION OF PROBLEM OR BENEFIT *(Continue on Reverse)*
	PART A - OFFSITE *(PUBLIC)* BENEFITS			
1	Protection of human life and property			
2	Protection of public health, safety, general welfare *(adverse effects)*			
3	Improved quality of the visible perimeter			
	Improved water quality or quantity			
	Improved fish or wildlife habitat *(Primary use only)*			
	Other *(Identify)*			
	SUB-TOTAL ➧			
	PART B - ONSITE *(PRIVATE)* BENEFITS			
3	Increased potential for protection *(income)*			
	Beneficial uses *(non-income)*			
	Other			
	SUB-TOTAL ➧			
	GRAND TOTAL *(Part A plus B)* ➧			

COMPLETED BY		**CONCURRED IN**	
SIGNATURE	DATE	CONSERVATION DISTRICT OR RECLAMATION COMMITTEE	DATE

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Appendix B. Characteristics of plants recommended for wildlife habitat development on surface mined lands.

TREES

		Drain-age			Light			Growth Rate					Plant Value to Wildlife									Multiple-Use Value										Fruiting Period					
Species	Min. pH	Dry	Med.	Wet	Sun	Sun/Shade	Shade	Slow	Med.	Fast	Dedic.	Evergr.	Browse	Fruit	Winter fr	Herbage	Mast	Seeds	Escape Cover	Travel Lane	Nesting	Screen	Hedgerows	Clumps	Erosion	Nurse	Pasture	Hayland	Borders	Christmas Trees	Timber	Spring	Summer	Fall	Winter	Years to Fruit	Additional Comments
TREES																																					
Red maple	4.5			x		x				x	x		x					x			x										x	x	x			1	Relatively short-lived.
Silver maple	4.0		x			x				x	x		x					x																		35-40	
Sugar maple	4.5-5.0		x				x		x		x		x					x			x												x	x	x	40	No insects diseases
European black alder	3.5-4.0		x -	x		x				x	x											x			x	x					x			x			Pulpwood
Sweet birch	4.5	x -	x				x		x		x		x					x	x														x	x		40	Cold-resistant
Yellow birch	7.0		x			x			x -	x	x		x					x													x		x			40	Cool temperatures
River birch	4.0			x		x				x	x		x					x	x														x	x			Cold-resistant
Paper birch	4.0		x		x					x	x			x	x			x															x	x	x	15	Cold-resistant; diseases.
European white birch	<3.5-4.0	x	x	x	x				x		x		x					x	x																		Diseases
Gray birch	<3.5	x	x	x	x				x					x	x							x	x	x		x								x	x		Tolerates poor soil. Thickets.
Chinese chestnut	4.5	x				x		x			x		x				x																				Large fruits.
Flowering dogwood	5.0		x				x	x			x		x	x					x		x												x	x			Cold-resistant
White ash	4.0		x	x		x				x	x		x					x																x		35	Fruit every 3-5 yrs.; disease.
Green ash	4.0		x	x		x				x	x		x					x																x		10	Direct seeding.
Black walnut	5.0	x	x		x			x			x						x		x												x			x		8	Fruits at irreg. intervals.
Eastern redcedar	5.0		x		x				x			x	x	x	x				x			x	x								x			x		10-25	Use south of PA.
European larch	4.0-5.0		x -	x	x					x	x-conif.											x														20	Injured by late spring frost.
Japanese larch	4.0-4.5		x		x				x -	x	x-conif.																										Disease/insects.

Continued

Appendix B (Continued)

Species	Min. pH	Drain-age			Light			Growth Rate					Plant Value to Wildlife									Multiple-Use Value										Fruiting Period				Years to Fruit	Additional Comments
		Dry	Med.	Wet	Sun	Sun/Shade	Shade	Slow	Med.	Fast	Dedic.	Evergr.	Browse	Fruit	Winter fr	Herbage	Mast	Seeds	Escape Cover	Travel Lane	Nesting	Screen	Hedgerows	Clumps	Erosion	Nurse	Pasture	Hayland	Borders	Christmas Trees	Timber	Spring	Summer	Fall	Winter		
Sweetgum	4.5		x		x				x		x			x	x			x	x															x		20-30	Heavy seed crops ev. 3rd year.
Tulip (Yellow) poplar	4.5		x		x					x	x		x					x				x									x			x		25	Tallest hardwood; southern tree.
Osage orange	7.0	x	x	x	x					x	x							x	x			x	x						x		x			x			Large fruit; extreme conditions.
Common apple	4.5		x		x					x	x		x	x				x	x		x													x			Insects; fungus. Hardy.
Crabapple	4.5-5.0		x			x			x		x		x	x	x				x															x			Winter-hardy.
Norway spruce	5.0		x				x	x				x	x					x	x			x							x	x							Windbreaks.
White spruce	4.5-5.0	x	x				x		x -	x		x	x					x	x			x	x	x					x	x			x	x		30	Windbreaks.
Jack pine	4.0-4.5	x				x		x				x	x					x	x															x		5	Northern species; poor, sandy soil.
Shortleaf pine	4.0-4.5		x		x					x		x	x					x	x			x									x	x		x	x	20	Southern regions, or below 1000 ft.
Austrian pine	3.5-4.0		x		x			x -	x			x	x					x	x			x									x						Dieback recently in Midwest.
Red (Norway) pine	3.5-4.5	x				x				x		x						x	x			x								x		x	x	x	x	20	Adapted to No. Appalachia.
Pitch pine	3.5-4.0		x		x			x				x	x	x	x			x	x													x		x	x	3	Shrub in north, 50 ft. tree, south.
White pine	4.5		x			x			x			x						x	x											x	x		x	x		10-20	Protect from wind; insects.
Scotch pine	4.0	x	x		x				x			x	x					x	x											x	x			x			Southern ranges.
Loblolly pine	4.0		x	x	x					x		x	x					x	x												x			x	x	2	Southern ranges.
Virginia pine	4.0	x	x		x			x				x	x					x	x			x														5	Southern ranges. Direct seeding.
American sycamore	4.0		x	x	x					x	x			x	x			x	x															x	x	25	Don't mix with locust.
Cottonwood (Eastern)	4.5-5.0	x	x				x			x	x	x	x					x													x	x			x	10	Pulpwood (glossy paper). pH > 7.3.

Continued

Appendix B (Continued)

		Drainage			Light			Growth Rate					Plant Value to Wildlife									Multiple-Use Value										Fruiting Period					Additional Comments
Species	Min. pH	Dry	Med.	Wet	Sun	Sun/Shade	Shade	Slow	Med.	Fast	Dedic.	Evergr.	Browse	Fruit	Winter fr	Herbage	Mast	Seeds	Escape Cove	Travel Lane	Nesting	Screen	Hedgerows	Clumps	Erosion	Nurse	Pasture	Hayland	Borders	Christmas Trees	Timber	Spring	Summer	Fall	Winter	Years to Fruit	
Aspens, native	5.0	x	x				x			x	x		x					x	x												x	x	x			20	
Hybrid poplars	4.0-4.5		x		x					x	x		x					x	x			x			x						x	Not impt.					Many diseases/ insects.
Black cherry	5.0		x			x				x	x		x	x					x												x		x	x		10	Heavy fruit ev. 3-4 yrs.
Sawtooth oak	4.0				x			x -	x		x		x				x		x																	6	30lb. acorns/ tree after 10 yr.
White oak	5.0	x	x			x			x		x		x				x		x												x					20	Long-lived. Heavy fruit ev. 4-10 yr.
Pin (Swamp) oak	5.0		x	x	x					x	x		x				x		x															x		15-25	Plant below 1500 feet elevation.
Chestnut oak	4.0	x	x			x			x		x						x																			1	V. large acorns; rocky sites.
(Northern) Red Oak	4.0	x	x			x				x	x		x				x		x												x			x	x	25	Heavy crops ev. 2-5 yrs.
Black locust	3.5-4.0		x		x					x	x		x	x	x			x	x						x	x								x	x	15	Direct seeding. Insects.
Sassafras	5.0		x		x					x	x		x	x				x	x				x										x	x		10	Forms thickets.
Mountain ash (American)	5.0		x		x						x			x	x				x			x										x	x	x	x		Mammals like red berries.

Continued

Appendix B (Continued)

SHRUBS AND VINES

Species	Min. pH	Drainage			Light			Growth Rate			Dedic.	Evergr.	Plant Value to Wildlife						Escape Cover	Travel Lane	Nesting	Multiple-Use Value								Fruiting Period				Years to Fruit	Additional Comments
		Dry	Med.	Wet	Sun	Sun/Shade	Shade	Slow	Med.	Fast			Browse	Fruit	Winter fr	Herbage	Mast	Seeds				Screen	Hedgerows	Clumps	Erosion	Nurse	Pasture	Hayland	Borders	Spring	Summer	Fall	Winter		
SHRUBS/VINES																																			
Indigobush	4.0	x				x					x		x	x	x			x	x						x	x					x	x	x	3	Direct seeding (pods): can become pest.
Black chokeberry	4.0		x	x		x		x-	x		x		x	x	x						x		x		x						x	x	x		Fruit of some plants rejected by birds.
Japanese barberry	4.0	x	x		x				x		x			x	x				x	x	x	x	x	x								x	x		Good survival in KY.
Common buttonbush				x		x			x		x			x	x			x	x		x			x						x		x	x		Forms island-like stands, wetlands.
Silky dogwood	4.5		x	x			x		x -	x	x		x	x					x				x	x	x				x		x	x		4-5	Neutral pH; likes moisture.
Gray dogwood	5.0					x		x			x		x	x					x		x		x	x	x				x			x		5	Shoots extend plant.
Washington hawthorn	5.5	x	x		x						x			x	x				x		x	x	x									x	x	4-5	Fireblight-resistant in dry spoil.
Russian olive	5.5	x	x			x				x	x			x					x			x	x							x		x	x		Good at pH 7.0. Wet snow damage.
Elaeagnus cherry	3.5-5.9	x	x	x				x			x		x	x					x		x	x	x		x						x				Early summer fruit. Vigorous, spreading.
Autumn olive	3.5-4.0	x	x			x				x	x		x	x					x	x		x	x		x	x			x			x	x	3-4	Best wildlife shrub for spoil reclamation.
Bicolor lespedeza	4.5-5.0		x		x						x					x		x	x	x						x			x			x		3	Direct seeding; good wildlife food & cover.
'Natob' bicolor lespedeza	4.5	x	x		x						x							x	x				x						x					3-6	Direct seeding; plant blocks for wildlife.
Japan lespedeza	4.5	x	x		x						x							x	x				x						x						Densest lespedeza if direct-seeded.
Amur privet	4.5-5.0	x	x			x				x		x		x					x			x	x						x			x		4	Persists in strong competition.
Japanese honeysuckle	4.5-6.0		x	x			x			x		Semi-Ev.	x	x					x						x						x	x		3-5	Noxious weed in South.
Amur honeysuckle	4.5-5.0		x	x		x		x			x		x	x					x			x	x									x	x	3-4	Do not direct-seed.

Continued

Appendix B (Continued)

Specie.	Min. pH	Drain-age			Light			Growth Rate					Plant Value to Wildlife									Multiple-Use Value							Fruiting Period				Years to Fruit	Additional Comments
		Dry	Med.	Wet	Sun	Sun/Shade	Shade	Slow	Med.	Fast	Dedic.	Evergr.	Browse	Fruit	Winter fr	Herbage	Mast	Seeds	Escape Cover	Travel Lane	Nesting	Screen	Hedgerows	Clumps	Erosion	Nurse	Pasture	Hayland	Borders	Spring	Summer	Fall	Winter		
Tatarian honeysuckle	4.5-5.0		x	x		x					x		x	x					x	x		x	x	x							x	x		3-4	Use in PA, not TN; no direct seeding.
Bayberry	4.0-5.0		x	x		x			x-	x	Semi-Ev.		x	x	x				x				x	x		x				x		x	x	5	Fruits from Sep-Apr; Deciduous in Midw.
Mugho pine	3.5	x	x			x		x				x							x																Ornamental.
Fragrant sumac	4.5	x	x				x	x -	x		x		x	x	x				x				x	x							x	x		5	Rapid cover; cold-tolerant.
Shining sumac	4.0-5.5	x	x			x					x		x	x	x				x				x	x								x		4	Cold-tolerant.
Smooth sumac	4.5	x				x				x	x		x	x	x				x				x	x								x	x	4	For mass planting in poor soil.
'Arnot' bristly locust	3.0-4.9	x			x					x	x								x	x			x	x	x	x			x			x	x	3-5	Good seed crops NOT consumed by wildl.
Multiflora rose	5.0	x	x	x	x					x	x				x			x	x	x	x	x	x	x					x			x		2-3	Unlawful in WV; hard to control spreading.
Rugosa rose	5.0-5.5	x			x					x	x		x	x				x	x	x	x	x	x		x				x		x	x		1-3	Resists diseases.
Memorial rose	4.0		x			x					Semi-Ev.							x	x						x							x			Erosion control at 8 yr.; runners.
Russet buffaloberry	4.0	x			x			x			x			x									x								x	x	x		Tolerates drought, cold, alkaline soil.
Coralberry	5.0		x			x				x	x		x	x	x				x			x	x		x							x		3	Hummingbirds like nectar; neutral pH good.
Arrowwood (Viburnum)	4.5		x			x			x		x			x					x		x		x	x					x		x	x		3-5	Poor survival in KY.
American cranberrybush	4.5		x	x		x		x -	x		x		x	x	x				x			x	x								x	x		3-5	Fruit edible by humans.

Continued

Appendix B (Continued)

HERBACEOUS-FORBS: LEGUMES

Species	Min. pH	Drainage			Growth Rate			Value to Wildlife					Multiple-Use Value					Life Span			Time of Planting				Flowering Period				Seeding Rate	Additional Comments
		Dry	Med.	Wet	Slow	Med.	Fast	Herbage	Seeds	Escape	Travel La.	Nesting	Clumps	Erosion	Nurse	Pasture	Hayland	Annual	Perennial	Reseeding annual	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	lb PLS/ acre	
HERBACEOUS-FORBS: LEGUMES																														
Partridge pea	5.0						x		x						x	x				x	x					x				Relatively short-lived (1-25 yrs.).
Crownvetch	3.5-5.5		x		x			x		x				x	x	x		x			x		x				x		10-20	Intermediate light; strong and robust.
Soybean	5.0						x	x	x						x			x			x					x			60	Can be planted early summer.
'Lathco' flatpea	4.5-5.5	x	x		x -	x		x	x	x				x	x	x			x		x					x			10-15	Intermediate light.
Lespedeza sericea	4.0-4.5				x			x	x	x				x	x	x	x		x		x					x			20	Excellent cover under many conditions.
Korean lespedeza	5.0						x		x	x					x	x				x	x					x			5-8	Adapted only to southern regions.
Common lespedeza	4.5						x		x	x					x	x		x			x					x			10-15	Fibrous ground cover.
Kobe lespedeza	4.5						x		x	x					x					x	x					x			20 (mixture)	Volunteers a stand each year.
Birdsfoot trefoil	3.5-5.0	x	x	x			x	x		x					x	x	x		x		x	x	x		x		x		9	Early summer planting winter hardy.
Alfalfa	5.5-6.0	x	x					x	x	x					x	x			x		x	x	x						12-20	
Sweet clover	5.5-6.0							x	x						x	x				x	x		x		x	x			4	Also biennial; flowers second year.
Kura clover	3.0-4.0	x	x	x	x			x	x					x	x				x		x		x							Winter hardy; erosion cont.; disease resistant.
Alsike clover	5.0-6.0							x	x						x				x		x		x		x		x			
Crimson clover	6.0	x	x	x			x	x	x	x				x	x	x	x	x			x		x				x	x		Ornamental value; winter hardy; winter grazing.
Zigzag clover	3.0-4.0	x	x	x				x	x						x				x		x		x							Winter hardy; disease/ insect resistance.

Continued

Species	Min. pH	Drainage			Growth Rate			Value to Wildlife					Multiple-Use Value					Life Span			Time of Planting				Flowering Period				Seeding Rate	Additional Comments
		Dry	Med.	Wet	Slow	Med.	Fast	Herbage	Seeds	Escape	Travel La.	Nesting	Clumps	Erosion	Nurse	Pasture	Hayland	Annual	Perennial	Reseeding annual	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	lb PLS/ acre	
Red clover	5.0-5.5							x	x						x	x	x		x		x		x		x		x		8-12	Also biennial; insect/ disease damage; flowers 2nd year.
White clover	5.0-5.5							x	x						x		x		x		x		x		x		x			Browse for wildlife.
Ladino clover	5.5							x	x						x				x		x		x		x		x			Preferred by wildlife, as other white clover.
Hairy vetch	5.5						x	x	x					x	x	x	x	x			x		x		x		x	x		Withstands below zero temperatures
Cowpea	4.5						x	x	x						x			x			x					x				

Continued

Appendix B (Continued)

HERBACEOUS-FORBS: NON-LEGUMES

Species	Min. pH	Drainage			Growth Rate			Value to Wildlife					Multiple-Use Value					Life Span			Time of Planting				Flowering Period				Seeding Rate	Additional Comments
		Dry	Med.	Wet	Slow	Med.	Fast	Herbage	Seeds	Escape	Travel La.	Nesting	Clumps	Erosion	Nurse	Pasture	Hayland	Annual	Perennial	Reseeding annual	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	lb PLS/ acre	
HERBACEOUS-FORBS: NON-LEGUMES																														
Sedges	4.0		x						x										x		x									Long-lived perennial; poor cover quality.
Buckwheat	4.5		x					x	x									x			x	x				x				
Sunflower	5.0		x						x									x			x	x								
Red sorrel	4.0									x									x											Good cover on low-fertility spoil.

Continued

Appendix B (Continued)

HERBACEOUS: GRASSES

Species	Min. pH	Drainage			Growth Rate			Value to Wildlife					Multiple-Use Value					Life Span			Time of Planting				Flowering Period				Seeding Rate	Additional Comments
		Dry	Med.	Wet	Slow	Med.	Fast	Herbage	Seeds	Escape	Travel La.	Nesting	Clumps	Erosion	Nurse	Pasture	Hayland	Annual	Perennial	Reseeding annual	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	lb PLS/ acre	
HERBACEOUS: GRASSES																														
Redtop	4.0-5.0	x	x	x			x	x	x	x				x		x	x		x		x		x		x		x		3-5	Tolerates flooding.
Big blue stem	4.5	x	x		x			x	x	x				x					x		x					x			12	Deep root system.
Little blue stem	4.5	x	x		x			x	x	x				x					x		x					x			12	More drought resistent than big blue stem.
Tall oat-grass	4.5	x	x						x	x							x		x		x		x		x		x		25	Good short-term cover.
Oats (spring)	4.5						x	x	x	x											x		x		x		x			For temporary cover; provides mulch.
Smooth bromegrass	5.0 5.5	x	x		x				x	x				x		x	x				x		x		x		x		17	Excellent drought resistance.
Bermudagrass	2.8-4.0	x	x				x	x	x	x				x		x			x		x					x	x			Good on low pH spoil.
Orchardgrass	4.5-5.0							x	x	x						x	x		x		x		x		x		x		20	Less winter hardy than tall fescue, bromegrass.
Japanese millet	4.5						x		x	x				x				x			x					x				Provides mulch material.
Weeping lovegrass	4.0-4.5	x	x				x	x	x	x				x					x		x					x			3	Not winter hardy in north. Short-lived.
Tall fescue/ Kentucky 31-Alta	4.5-5.5	x	x				x		x	x						x	x		x		x		x		x		x		20	May suppress slow-growing woody species.
Red fescue	4.5	x	x	x					x	x									x		x		x		x		x			Tolerates flooding and low fertility.
Ryegrass, annual	4.5-5.0						x	x	x	x				x		x	x	x			x		x		x		x		20	Rapid cover and mulch production.
Ryegrass, perennial	4.5-5.5		x	x			x	x	x	x				x	x	x	x		x		x		x		x		x			May suppress slow-growing plants

Continued

Appendix B (Concluded)

Species		Drainage			Growth Rate			Value to Wildlife					Multiple-Use Value					Life Span			Time of Planting				Flowering Period				Seeding Rate	Additional Comments
	Min. pH	Dry	Med.	Wet	Slow	Med.	Fast	Herbage	Seeds	Escape	Travel La.	Nesting	Clumps	Erosion	Nurse	Pasture	Hayland	Annual	Perennial	Reseeding annual	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	lb PLS/ acre	
Deertongue	4.0	x	x	x				x	x	x				x					x		x		x			x				Persists more than 10 years.
Proso millet	5.0						x		x					x				x			x	x				x				Good mulch material.
Switchgrass	4.0-5.0	x	x			x		x	x	x				x		x	x		x		x		x	x		x			10-20	Takes two years to develop. Lasts 10+ yrs.
Pearl millet	4.5						x		x					x				x			x					x				Good mulch material.
Reed canarygrass	4.5-5.0	x	x	x	x				x	x						x			x		x		x						17	Competes with crown-vetch; lasts 10+ years.
Timothy	5.0							x	x					x		x	x		x		x		x		x		x		10	Adapted to northern but not southern Appalachia.
Kentucky bluegrass	5.0		x	x	x						x					x			x		x		x							Dormant during hot, dry weather.
Rye (winter)	4.5						x	x	x									x			x		x		x		x			Will produce cover if sown in spring.
Foxtail millet	4.5						x		x	x				x				x			x	x							20-30	Rapid cover; good mulch.
German millet	4.5						x		x	x				x				x			x					x			20	Good mulch material.
Indiangrass	4.5							x	x	x									x		x					x				Spreads to adjacent areas in fertile soil.
Grain sorghum	5.0						x		x									x			x					x			5	Fibrous roots.
Sudangrass x sorghum hybrid							x		x					x				x			x					x				Fibrous roots; good mulch.
Wheat	4.5-5.5						x	x	x	x				x			x	x			x		x						1½ bu.	Fibrous roots.

Appendix C-1. SOURCES OF PLANTING STOCK AND SEED OF PLANTS RECOMMENDED FOR WILDLIFE HABITAT DEVELOPMENT ON SURFACE MINES

COMMON NAME	SCIENTIFIC NAME	SOURCE: SEED	PLANTING STOCK
TREES			
Red maple	*Acer rubrum*	1,2	2,3,4,5,6,7,8,9,10,11, 12,13,14,15,25,58,59, 132,138
Silver maple	*Acer saccharinum*	1,2,14	4,5,8,9,10,11,13,14,16, 17,25,58,59,132,138
Sugar maple	*Acer saccharum*	1,18	3,4,5,6,7,8,9,10,11,12, 13,14,16,17,59,138
European (black) alder	*Alnus glutinosa*	1	14,17,19,20,21,22,25, 45,46,54,59,132
Sweet birch	*Betula lenta*	1,2	14,16,23
Yellow birch	*Betula lutea*		2,47,48
River birch	*Betula nigra*	1	4,5,11,14,49,58,138
Paper birch	*Betula papyrifera*		3,7,8,9,14,16,24,46,47, 48,49,50,51,52,53,54,55
European white birch	*Betula pendula*	1,14	3,7,8,10,11,14,16,23,24, 25,26,49,58,59,138
Gray birch	*Betula populifolia*		
Chinese chestnut	*Castanea mollissima*		4,5,6,7,8,9,10,11,12,13, 14,16,19,22,23,25,26,27, 58,59,136,138

Continued

Appendix C-1. (Continued).

COMMON NAME	SCIENTIFIC NAME	SOURCE: SEED	PLANTING STOCK
Trees, Continued			
Flowering dogwood	*Cornus florida*	1,2,14	2,3,4,5,7,8,9,10,11, 13,14,16,23,24,25, 26,45,46,50,51,53, 56,58,59,60,61,75, 85,132,133,136,138
White ash	*Fraxinus americana*	1	5,13,14,15,16,17,19, 132
Green ash	*Fraxinus pennsylvanica*	1	2,4,5,8,9,10,11,13, 14,16,17,58,59,138
Black walnut	*Juglans nigra*	1,22	2,4,5,7,8,9,10,11, 13,14,15,16,17,19, 22,23,24,28,59,138
Eastern redcedar	*Juniperus virginiana*	1,14,135	1,3,7,8,16,26,28,54, 59
European larch	*Larix decidua*	1,14	6,7,9,10,12,14,16,22, 23,26
Japanese larch	*Larix kaempferi, L. leptolepis*	1	7,16
Sweetgum	*Liquidambar styraciflua*	1,14,135	3,4,5,6,8,9,10,11,12, 13,14,16,17,23,24,28, 31,58,138
Tulip (yellow) poplar	*Liriodendron tulipifera*	1,14	4,5,6,7,8,9,10,11,13, 14,15,16,17,19,22,25, 28,58,132,138

Continued

Appendix C-1. (Continued).

COMMON NAME	SCIENTIFIC NAME	SOURCE:	
		SEED	PLANTING STOCK
Trees, Continued			
Osage orange	*Maclura pomifera*		
Common apple	*Malus pumila*		11,49
Crabapple	*Malus spp.*	1	5,8,10,11,13,14,17,25,45,46,49,52,53,56,58,59,132
Norway spruce	*Picea abies*	1,14,59	3,6,7,8,9,10,12,14,15,16,17,20,22,23,24,26,28,31,32,33,59,89,132,135,136,137,138
White spruce	*Picea glauca*	1,59,135	6,7,8,9,10,12,14,16,20,23,24,26,31,32,33,59,132,135,136,138
Jack pine	*Pinus banksiana*	59	59
Shortleaf pine	*Pinus echinata*	1	17,19,22,28
Austrian pine	*Pinus nigra*	1,14,135	3,6,7,8,9,10,12,14,16,17,20,23,24,26,31,32,33,59,135,136,137,138
Red (Norway) pine	*Pinus resinosa*	1,59	6,7,8,9,10,12,14,15,16,17,20,22,26,28,31,32,33,59,136

Continued

Appendix C-1. (Continued).

COMMON NAME	SCIENTIFIC NAME	SOURCE: SEED	PLANTING STOCK
Trees, Continued			
Pitch pine	*Pinus rigida*	1	20,22,24,28
White pine (Eastern)	*Pinus strobus*	1,14,59, 135	3,6,7,8,9,10,12,14, 15,16,17,19,20,21, 22,23,24,26,28,31, 32,33,59,132,135, 136,138
Scotch pine	*Pinus sylvestris*	1,14,135	6,7,8,9,10,11,12, 14,15,16,19,22,23, 24,26,28,31,32,33, 59,132,135,136,137, 138
Loblolly pine	*Pinus taeda*	1	15,19,21,28
Virginia pine	*Pinus virginiana*	1	15,19,20,21,22,28, 132
American sycamore	*Platanus occidentalis*	1,2	4,5,11,13,14,15,17, 19,22,23,28,50,132, 138
Cottonwood (Eastern)	*Populus deltoides*		11,59
Aspens, native	*Populus spp.*		16
Poplars, hybrid	*Populus spp.*		14,34,51,57,58
Black cherry	*Prunus serotina*		2,14,16,49,54,59

Continued

Appendix C-1. (Continued).

COMMON NAME	SCIENTIFIC NAME	SOURCE: SEED	PLANTING STOCK
Trees, Continued			
Sawtooth oak	*Quercus acutissima*		4,5,11,13,16,21,25,27,28,45,52,56,132,138
White oak	*Quercus alba*	14	5,11,13,14,16,17,19,27,58
Pin (swamp) oak	*Quercus palustrus*	14	3,4,5,8,10,11,13,14,15,16,17,19,22,23,26,27,28,31,50,58,59,132,138
Chestnut oak	*Quercus prinus*		11,14,16
(Northern) red oak	*Quercus rubra*	1,14,22	3,5,8,10,11,13,14,15,16,17,22,24,27,28,31,58,59,132,138
Black locust	*Robinia pseudoacacia*	1,14,35,41,131,134	5,8,11,13,14,15,16,17,19,20,21,22,28,132,138
Sassafras	*Sassafras albidum*	1	2,3,5,11,14,46,52
Mountain ash (American)	*Sorbus americana*		2,9,51,52,57,59,60

Continued

Appendix C-1. (Continued).

COMMON NAME	SCIENTIFIC NAME	SOURCE: SEED	PLANTING STOCK
SHRUBS/VINES			
Indigobush	*Amorpha fruticosa*	1	5
Black chokeberry	*Aronia melanocarpa*		3,5,14,45,60
Japanese barberry	*Berberis thunbergii*		
Common buttonbush	*Cephalanthus occidentalis*		
Silky dogwood	*Cornus amomum*	1,2	15,16,17,58,59,132
Gray dogwood	*Cornus racemosa*	1,2	2,3,10,16,17,22,58,59
Washington hawthorn	*Crataegus phaenopyrum*	1	3,5,11,14,17,25,58,59,138
Russian olive	*Elaeagnus angustifolia*	1,14	4,5,8,11,13,16,24,26,58,59
Elaeagnus cherry	*Elaeagnus multiflora*		
Autumn olive	*Elaeagnus umbellata*	1,2,14	2,3,5,7,8,10,11,13,15,16,17,19,21,22,23,24,25,26,28,31,45,46,49,50,52,53,57,58,59,132,136,138
Bicolor lespedeza	*Lespedeza bicolor*	1,18,37,43,74,83,89,130,134	5,11,19,21,28,38,64,77

Continued

Appendix C-1. (Continued).

COMMON NAME	SCIENTIFIC NAME	SOURCE: SEED	PLANTING STOCK
Shrubs/Vines, Continued			
'Natob' bicolor lespedeza	*Lespedeza bicolor Turcz*	1,18,37, 77	5,11,19,21,28
Japan lespedeza	*Lespedeza japonica*		43,123
Amur privet	*Ligustrum amurense*		4,5,11,13,14,16,27, 36,52,138
Japanese honeysuckle	*Lonicera japonica*	1	4,5,11,13,14,36,46, 49,52,57,62,138,
Amur honeysuckle	*Lonicera Maackii*		3,5,16,24,25,58
Tatarian honeysuckle	*Lonicera tatarica*	1	4,5,7,8,13,14,23,24, 25,36,59
Bayberry	*Myrica pennsylvanica*	1,14	3,10,25,36
Mugho pine	*Pinus mugomughus*	59	3,7,8,9,13,14,24,25, 26,46,51,52,53,55, 59,61
Fragrant sumac	*Rhus aromatica*	1	3,5,11,36,45,46,49, 52,53,56
Shining sumac	*Rhus copallina*		5,14,43,46,52,60
Smooth sumac	*Rhus glabra*	1,2	1,5,13,47,49,52,58,59
'Arnot' bristly locust	*Robinia fertilis*	8,16,39, 84	8,10,15,16,22,28,32, 58

Continued

Appendix C-1. (Continued).

COMMON NAME	SCIENTIFIC NAME	SOURCE: SEED	PLANTING STOCK
Shrubs/Vines, Continued			
Multiflora rose	*Rosa multiflora*	1,14	4,5,8,11,16,23,26, 58,59
Rugosa rose	*Rosa rugosa*	1,14	5,7,8,10,11,13,14,16, 24,25,26,36,41,50,52
Memorial rose	*Rosa wichuraiana*		11,46,56
Russet buffaloberry	*Shepherdia argentea*		
Coralberry	*Symphoricarpos orbiculatus*	1,2	2,4,5,11,13,46,49,52, 56,57
Arrowwood	*Viburnum dentatum*	1	5,8,11,13,36,47,48, 49,52,53,56,57,58
American cranberrybush	*Viburnum trilobum*		8,10,14,17,25,31,36, 46,49,52,54,56
HERBACEOUS - FORBS: LEGUMES			
Partridge pea	*Cassia fasciculata*	18,43,74, 89	

Continued

Appendix C-1. (Continued).

COMMON NAME	SCIENTIFIC NAME	SOURCE:	
		SEED	PLANTING STOCK
Herbaceous-Forbs: Legumes, Continued			
Crownvetch	*Coronilla varia*	1,5,7,9,11,12,16 18,20,34,35,41,42, 44,59,64,65,71,72, 74,76,77,78,79,80, 81,82	6,9,11,12,14, 16,34,39,41, 58,59,64,65, 68,69,70,74, 77,82,138
Soybean	*Glycine max*		
'Lathco' flatpea	*Lathyrus sylvestris*	39,40,41,42,65,71, 72,73	
Lespedeza sericea	*Lespedeza cuneata*	35,41,64,74,83,89, 90,105,106,108,109, 110,111,112,113,114, 115,116,117	
Korean lespedeza	*Lespedeza stipulacea*	35,41,64,74,89,90,91	
Common lespedeza	*Lespedeza striata*		
Kobe lespedeza	*Lespedeza striata var.*	41,64,74,89,90,91,122	
Birdsfoot trefoil	*Lotus corniculatus*	74	74
Alfalfa	*Medicago sativa, M. media*		
Sweet clover	*Melilotus spp.*	64,71,83,89,124,125,126	
Kura clover	*Trifolium ambiguum*		
Alsike clover	*Trifolium hybridum*		

Continued

Appendix C-1. (Continued).

COMMON NAME	SCIENTIFIC NAME	SOURCE: SEED	PLANTING STOCK
Herbaceous-Forbs: Legumes, Continued			
Crimson clover	*Trifolium incarnatum*	43,64,86,89,90, 121,125,130	
Zigzag clover	*Trifolium medium*		
Red clover	*Trifolium pratense*		
White clover	*Trifolium repens*	29,43,74,89,90, 121,125,130	
Ladino clover	*Trifolium repens forma Lodigense*		
Hairy vetch	*Vicia villose*	29,43,121,126, 130	
Cowpea	*Vigna sinensis*	64,121,125,128	
HERBACEOUS - FORBS: NON-LEGUMES			
Sedges	*Carex spp.*		
Buckwheat	*Fagopyrum spp.*	35,37,41,65,66, 74	
Sunflower	*Helianthus annuus*	1,29,43,64,74, 89,121	

Continued

Appendix C-1. (Continued).

COMMON NAME	SCIENTIFIC NAME	SOURCE: SEED	PLANTING STOCK
Herbaceous-Forbs: Non-Legumes, Continued			
Red sorrel	*Rumex acetosella*		
HERBACEOUS - GRASSES			
Redtop	*Agrostis alba*		
Big blue stem	*Andropogon gerardi*	64,71,74,79,86,87	
Little blue stem	*Andropogon scoparius*	64,71,74,78,79,86,87	
Tall oatgrass	*Arrhenatherum elatius*		
Oats (spring)	*Avena spp.*		
Smooth bromegrass	*Bromus inermis*		
Bermudagrass	*Cynodon dactylon*	37,41,43,64,67,92,93,94,95,96,97,98,99,100,101,102,103,104	
Orchardgrass	*Dactylis glomerata*		
Japanese millet	*Echinochloa spp.*	29,30,35,37,40,41,43,64,66,67,68,72,74,89,90,120,121	

Continued

Appendix C-1. (Continued).

COMMON NAME	SCIENTIFIC NAME	SOURCE: SEED	PLANTING STOCK
Herbaceous - Grasses, Continued			
Weeping lovegrass	*Eragrostis curvula*	35,37,40,41,64,66,72,79,86,87,89,90,118,119	
Tall fescue/Kentucky 31-Alta	*Festuca arundinacea, var.*		
Red fescue	*Festuca rubra*		
Ryegrass, annual	*Lolium multiflorum*		
Ryegrass, perennial	*Lolium perenne*		
Deertongue	*Panicum clandestinum*	39,40,41,42,44,47,66,72,88	
Proso millet	*Panicum miliaceum*	8,18,72,74	
Switchgrass	*Panicum virgatum*	41,64,66,71,74,78,79,86	
Pearl millet	*Pennisetum glaucum*	29,43,64,74,83,89,121	
Reed canarygrass	*Phalaris arundinacea*	35,37,40,41,64,66,67,68,71,72,74,78,79,80,89	
Timothy	*Phleum pratense*		
Kentucky bluegrass	*Poa pratensis*		

Continued

Appendix C-1. (Concluded).

COMMON NAME	SCIENTIFIC NAME	SOURCE: SEED	PLANTING STOCK
Herbaceous - Grasses, Continued			
Rye (winter)	*Secale spp.*	139	
Foxtail millet	*Setaria italica*	64,74,86,121,125,127	
German millet	*Setaria italica var.*		
Indiangrass	*Sorghastrum nutans*	64,71,79,86,87	
Grain sorghum	*Sorghum bicolor moench*	128,129	
Sudangrass x sorghum hybrid	*Sorghum bicolor (L.) Moench x Sorghum Sudanese (Piper) Stapf*	74	
Wheat	*Triticum aestivum*	74	

Appendix C-2. SUPPLIERS OF PLANTING STOCK AND SEED OF PLANTS REFERRED TO IN APPENDICES B and C-1.

Code No.	Supplier
1	Herbst Brothers Seedsmen, Inc. 1000 N. Main Street Brewster, NY 10509 (914-279-2971)
2	Harvey's Forest Tree, Shrub Seed & Seedlings 198 Woodridge Drive Beaver, PA 15009 (412-774-0176)
3	Hess' Nurseries, Inc. P.O. Box 326, Route 553 Cedarville, NJ 08311 (609-447-4213)
4	Triangle Nursery Route 2, Box 299 McMinnville TN 37110 (615-668-8022)
5	Warren County Nursery, Inc. Route 2, Box 204 McMinnville, TN 37710 (615-668-8941)
6	Canale's Nursery Shelocta, PA 15775 (412-354-2801)
7	Carino's Nurseries Box 538 Indiana, PA 15701 (412-463-3350)
8	Pine Grove Nursery RD 3 Clearfield, PA 16830 (814-765-2363)
9	Eccles Nurseries Rimersburg, PA 16248 (814-473-6265)

Appendix C-2. (Continued).

Code No.	Supplier
10	Possum Hollow Nurseries 6909 Henley Street Philadelphia, PA 19119 (215-843-0332)
11	Harvest Farms P.O. Box 278 Morrison, TN 37357 (615-668-4171)
12	C & E Nursery, Inc. Box 556 Indiana, PA 15701 (412-463-7896)
13	Forest Nursery Co. Route 2, Box 118-A McMinnville, TN 37110 (615-473-2133)
14	Mellinger's 2310 West South Range Road North Lima, OH 44452 (216-549-9861)
15	Maryland Dept. of Natural Resources Buckingham Forest Nursery Harmans, MD 21077 (301-768-7367)
16	Musser Forests, Inc. Indiana, PA 15701 (412-465-5686)
17	Ohio Dept. of Natural Resources Division of Forestry Fountain Square Columbus, OH 43224 (614-466-7842)
18	Montgomery Seed & Supply Co., Inc. 243 Dexter Avenue P.O. Drawer 349 Montgomery, AL 36101 (205-265-8241)

Appendix C-2. (Continued).

Code No.	Supplier
19	Kentucky Dam Nursery Box 97 Gilbertsville, KY 42044 (502-362-8331)
20	Commonwealth of Pennsylvania Dept. of Environmental Resources Bureau of Forestry, P.O. Box 1467 Harrisburg, PA 17120 (717-787-2708)
21	The Tennessee Division of Forestry 2611 West End Avenue Nashville, TN 37203 (615-741-3326)
22	West Virginia Dept. of Natural Resources Division of Forestry 1800 Washington Street East Charleston, WV 25305
23	Clair Johnston & Sons Nurseries Creekside, PA 15732 (412-463-8456)
24	Ryland Croshaw Nursery 45 West Main Street Columbus, NJ 08022 (609-298-0477)
25	The Tingle Nursery Company Pittsville, MD 21850 (301-835-2101)
26	Flickingers' Nursery Sagamore, PA 16250 (412-783-6528)
27	Cantrell & Cantrell Nursery Co. Smithville, TN 37166 (615-597-7244)
28	Virginia Division of Forestry Box 3758 Charlottesville, VA 22903 (804-977-6555)

Appendix C-2. (Continued).

Code No.	Supplier
29	Bomar Feed and Seed Company 2513-7th Street Tuscaloosa, AL 35401
30	Norala Seed Company P.O. Box 1770 Birmingham, AL 35201
31	Pallack Bros. Nurseries, Inc. Harmony, PA 16037 (412-452-9110)
32	Baker's Tree Nursery 13895 Garfield Road Salem, OH 44460 (216-537-3903)
33	Sam Dible Nursery R.F.D. 3 Box 86 Shelocta, PA 15774 (412-726-5377)
34	Miles W. Fry & Son Nursery Frysville-Ephrata R.D. 3, PA 17522
35	The Ohio Seed Company West Jefferson, OH 43162 (614-870-8366)
36	Congdon Weller Wholesale Nursery, Inc. Mile Block Road North Collins, NY 14111 (716-337-2476)
37	William G. Scarlett & Company 608-632 President Street Baltimore, MD 21202 (301-752-3415)
38	J. E. Brown P.O. Box 8 Monroe, GA 30655

Appendix C-2. (Continued).

Code No.	Supplier
39	H. J. Brusca Nursery, Inc. 307 Horsham Road Horsham, PA 19044
40	Whitney-Dickinson Seeds, Inc. 52 Leslie Street P.O. Box 250 Buffalo, NY 14240 (716-896-1111)
41	Stanford Seed Company P.O. Box 230 Plymouth Meeting, PA 19462 (215-825-1240)
42	Valley Seeding Company, Inc. Sugarloaf, PA 18249 (717-788-3338)
43	R. E. Lambert & Son Darlington, AL 36730 (205-682-4265)
44	Big Flats Seed Company, Inc. P.O. Box 271 Big Flats, NY 14814 (607-257-0809)
45	Cully Nursery RR #5 Jacksonville, IL 62650
46	Lake County Nursery Exchange Box 122 Perry, OH 44081
47	Ivy-Dale Nursery Route #1, Upper River Road Gallipolis, OH 45631
48	Exeter Wild Flower Gardens Exeter, NH 03833
49	Sherman Nursery Company Charles City, IA 50616 (515-228-1124)

Appendix C-2. (Continued).

Code No.	Supplier
50	Gulf Stream Nursery Wachapreague, VA 23480
51	Pikes Peak Nurseries 801 Water Street P.O. Box 670 Indiana, PA 15701
52	Princeton Nurseries P.O. Box 191 Princeton, NJ 08540
53	Zelenka Evergreen Nursery, Inc. 16127 Winans Grand Haven, MI 49417
54	Evergreen Nursery Company Sturgeon Bay, WI 54235
55	Nepco Lake Nursery Port Edwards, WI 54469
56	Cole Nursery Company R.R. 1 Circleville, OH 43113
57	Kelly Brothers Nurseries, Inc. Dansville, NY 14437
58	Forrest Keeling Nursery Elsberry, MO 63343
59	Vans Pines, Inc. Route 1 West Olive, MI 49460
60	Gardens of the Blue Ridge Ashford McDowell County, NC 28603
61	Appalachian Nurseries Waynesboro, PA 17268
62	Hansen's Ground Covers 1268 Montgomery Avenue Narberth,PA 19072

Appendix C-2. (Continued).

Code No.	Supplier
63	Mehlenbacher Seed Farms Castile, NY 14427
64	Mangelsdorf & Bros., Inc. Box 327 St. Louis, MO 63166
65	Ernst Crownvetch Farms RD #5 Meadville, PA 16335
66	Beachley-Hardy Seed Co. Shiremanstown, PA 17091
67	Northrup King & Company Minneapolis, MN 55440
68	Wildlife Nurseries Box 399 Oshkosh, WI 54901
69	Plants For You Route #3 Myra Sta. Road Urbana, IL 61801
70	Coronilla Hills 9201 McKinley Street Omaha, NB 68122
71	Miller Seed Company 1540 Cornhusker Highway Lincoln, NB 68500
72	Agway, Inc. Seed Division Box 1333 Syracuse, NY 13201
73	Moorer Seed Company 333 Walnut Street Ext. Prattville, AL 36067
74	Kester's Wild Game Food Nurseries, Inc. P.O. Box V Om[illegible] WI 54963

Appendix C-2. (Continued).

Code No.	Supplier
75	Waynesboro Nurseries, Inc. Waynesboro, VA 22980
76	Robert Baker Baker, WV 26801
77	Douglas Catlett Box 129 Route #3 Martinsburg, WV 25401
78	Lynnville Seed Company Lynnville, IA 50153
79	Stock Seed Farms R.R. Box 112 Murdock, NB 68407
80	Agri-Culver, Inc. Trumansburg, NY 14886
81	Harvey Corson Muncy, PA 17756
82	Grasslyn, Inc. 641 Pine Grove Road State College, PA 16801
83	Ring Around Products, Inc. P.O. Box 1770 Birmingham, AL 35201
84	Frank Worst 811 McColmont Franklin, PA 16323
85	Cartwright Nursery Company Collierville, TN 38017
86	Sharp Bros. Seed Company Healy, KS 67850
87	Tom Munger Seed Company P.O. Box 975 Enid, OK 73701

Appendix C-2. (Continued).

Code No.	Supplier
88	B_2 Seeding Company R.D. 4, Box 226 Towanda, PA 18848
89	Kaufman Seeds, Inc. P.O. Box 398 Ashdown, OK 71822
90	Adams-Briscoe Seed Company Jackson, GA 30233
91	Farmers Mutual Exchange Edgefield Road Johnson, SC 29832
92	E. B. Averett, Jr. Route 2, Box 153 Oxford, NC 27565
93	LeMay Turner Route 1, Box 292 Clayton, NC 27520
94	Arran Farms, Inc. Tomahawk, NC 28465
95	Edward D. McGowen Box 16 Turkey, NC 28393
96	Kenneth E. Hancock Box 207 Stedman, NC 28391
97	Hoyle R. Canady Box 359 Hope Mills, NC 28348
98	Dewitt Gaddy Box 139 Morven, NC 28119
99	John McIver 1002 Jefferson Street Hamlet, NC 28345

Appendix C-2. (Continued).

Code No.	Supplier
100	L. G. Dewitt Farms Ellerbe, NC 28338
101	L. C. Perdue, Jr. Route 6 Henderson, NC 27536
102	R. D. Smith Route 4 Henderson, NC 27536
103	Raleigh Turfgrass Farms 611 Rogers Lane Raleigh, NC 27610
104	Georgia Seed Development Comm. Whitehall Road Athens, GA 30601
105	W. G. Weaver & Sons Seed Company 3681 Wyandotte Avenue Winston Salem, NC 27107
106	Payne Brothers Seed Company P.O. Box 1395 Charlotte, NC 28232
107	Dan V. Sprouse Route 2 Jonesville, SC 29353
108	Horace Porter Route 4 Box 323A Lancaster, SC 29720
109	Cecil Stewart 923 E. Garrison Boulevard Gastonia, NC 28052
110	C. M. Banks Route 2 Chester, SC 29706
111	George A. Wheeler, Jr. Route 6 Gaffney, SC 29340

Appendix C-2. (Continued).

Code No.	Supplier
112	R. G. Christopher Hodges, SC 29653
113	Norwood Farms McBee, SC 29101
114	Ronnie O'Neal Route 2 Anderson, SC 29621
115	Ira T. Cousins, Inc. Box 463 Newberry, SC 29108
116	J. J. Ramey Route 1 Westminster, SC 29693
117	Fred I. Hollis, Inc. Eli Street Bennettsville, SC 29512
118	Southern Seeding Inc. Highway 264L Middlesex, NC 27557
119	Wyatt Quarles Seed Company Raleigh, NC 27602
120	Reddoch Farm Supply 338 Molton Montgomery, AL 36102
121	Sawan Seed 1324 Railroad Avenue Guntersville, AL 35976
122	The Douglas Company P.O. Box 37 Ruby, SC 29741
123	Walter Schrader 428 Pickens Court Rock Hill, SC 29741

Appendix C-2. (Continued).

Code No.	Supplier
124	Independent Seed & Wire, Inc. 4206 Produce Road Louisville, KY 40218
125	Johnston Seed Company P.O. Box 1392 Enid, OK 73701
126	Wilson Seed Farms Polk, NB 68654
127	Harley Seed Company Box 589 Vinita, OK 74301
128	Melot's Wildlife Seed Box 154 Bethany, OK 73008
129	Benny J. Gallagar P.O. Box 10254 Corpus Christi, TX 78410
130	H. G. Hastings Company, Inc. 434 Marietta Street, N.W. Atlanta, GA 30313
131	Kentucky Seed Company Div. of Northrup, King & Company P.O. Box 1261 Louisville, KY 40201 (502-582-2687)
132	Maryland Forest Service Dept. of Natural Resources Tawes State Office Building 580 Taylor Avenue Annapolis, MD 21401 (301-269-3776)
133	Commercial Nursery Company Decherd, TN 37324 (615-923-5525)
134	Caudill Seed & Warehouse Company 1201 Story Avenue Louisville, KY 40204 (502-583-4402)

Appendix C-2. (Concluded).

Code No.	Supplier
135	Girard Nurseries P.O. Box 191 Princeton, NJ 08540 (609-924-1776)
136	Willow Springs Nursery R.D. 2 Indiana, PA 15701 (412-463-3460)
137	Nye Branch Evergreen Nursery Star Route Punxsutawney,PA 15767 (814-938-7047)
138	Boyd Brothers Company P.O. Box 788 McMinnville, TN 37110
139	Charles Stott and Company 1680 Wisconsin Avenue, N.W. Washington, D.C. 20007 (202-333-5200)

Appendix D. LIST OF CONTACTS FOR OBTAINING FISH FOR STOCKING OF IMPOUNDMENTS

SPECIES ABBREVIATIONS

Amur pike	AMP
Arctic grayling	ARG
Atlantic salmon	ATS
Blue catfish	BCF
Blue X channel catfish	BCFCCF
Bigmouth buffalo	BIB
Brook trout	BKT
Black bullhead	BLB
Black crappie	BLC
Bluegill	BLG
Blue pike	BLP
Brown trout	BNT
Bowfin	BON
Brown bullhead	BRB
Carp	CAP
Channel catfish	CCF
Chum salmon	CHS
Coho salmon	COS
Cutthroat trout	CUT
Darters	DAR
Dolly varden	DOV
Dolly varden X brook trout	DOVBKT
Flathead catfish	FCF
Fall chinook salmon	FCS
Fathead minnow	FHM
Freshwater drum	FRD
Gars	GAR
Gila trout	GIT
Goldfish	GOF
Golden trout	GOT
Green sunfish	GSF
Herrings	HEG
Killifishes	KIH
Kokanee	KOE
Landlocked Atlantic salmon	LAS
Lake trout	LAT
Lampreys	LAY
Livebearers	LIR
Largemouth bass	LMB
Mooneyes	MOE
Miscellaneous	MSC
Muskellunge	MUE
Mudminnows	MUW
Northern pike	NOP
Other catfishes	OCF
Other salmonids (TR. &S.)	OSA
Other sunfishes	OSF
Other minnows	OTM
Other pikes	OTP
Other suckers	OTS
Paddlefish	PAH
Pink salmon	PKS
Rainbow trout (kamploops)	RBT
Rainbow X steelhead trout	RBTSTT
Redear sunfish	RSF
Smallmouth buffalo	SAB
Sauger	SAR
Spring chinook salmon	SCS
Smallmouth bass	SMB
Sockeye salmon	SOS
Spotted bass	SPB
Striped bass	STB
Sticklebacks	STK
Sturgeons	STN
Steelhead trout	STT
Walleye	WAE
Walleye X sauger	WAESAR
Warmouth	WAM
Winter chinook salmon	WCS
White catfish	WCF
White bass	WHB
White X striped bass	WHBSTB
White crappie	WHC
White perch	WHP
Yellow bullhead	YEB
Yellow perch	YEP
Yellow bass	YLB

Appendix D. LIST OF CONTACTS FOR STATE ASSISTANCE IN OBTAINING FISH FOR STOCKING OF IMPOUNDMENTS*

ALABAMA

CONTACT:

C. E. White, Jr.
Assistant Chief, Fisheries Section
Alabama Department of Conservation
and Natural Resources
Game and Fish Division
64 North Union Street
Montgomery, AL 36130

STATE POLICY: Alabama will provide bluegill, redear sunfish and largemouth bass, free of charge to stock private ponds that meet certain requirements. Fishery Biologist will visit pond for pre-stocking inspection.

TO OBTAIN AGREEMENT FORMS: Write Contact (above) for Application For Fish.

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*Based on latest information available. Some of the listings may not be applicable currently.

ILLINOIS

CONTACT:

Mike Conlin
Department of Conservation
Division of Fisheries
100 E. Washington Street
Springfield, IL 62706
(217) 782-6424

STATE POLICY:

Illinois will sell at cost to owners of private water areas for stocking purposes, largemouth bass, bluegill and redear fingerling fish. The water area must meet certain "minimum essentials", and the district biologist will determine stocking rate. The Department of Conservation may also sell excess minnows, frogs, turtles, or mussels or their eggs.

TO OBTAIN AGREEMENT FORMS:

Write for Application for Purchase of Fish, to contact shown above.

INDIANA

CONTACT:

Joseph L. Janisch
Fisheries Staff Specialist
Division of Fish and Wildlife
607 State Office Building
Indianapolis, IN 46204
(317) 633-7696

STATE POLICY:

Indiana will provide free fingerling fish (largemouth bass and bluegills), and owner may stock catfish in addition (but nothing else for the following 5 years), if the pond meets Division of Fish and Wildlife requirements, and if the owner agrees to keep pond open to public fishing for 5 years following stocking. (No fishing license required for private ponds).

TO OBTAIN AGREEMENT FORMS:

Write or call Contact (above) for Pond Stocking Agreement, and Pond Stocking Recommendations and Policy.

KENTUCKY

CONTACT:

Charles C. Bowers, Jr.
Director of Fisheries
Fish and Wildlife Resources
Division of Fisheries
592 East Main Street
Frankfort, KY 40601
(502) 564-3596

STATE POLICY:

Kentucky will provide free fish (bass, bluegill, and channel catfish) for stocking in any body of water in the state. The conservation officer (a county representative) must examine the body of water, and the landowner and the officer must sign a farm pond application. Fish are delivered on a specified date to the county.

TO OBTAIN AGREEMENT FORMS:

Write Contact (above) for Farm Pond Application.

Appendix D. (Continued).

MARYLAND

CONTACT:	David A. Wharton, Chief Inland Fisheries Maryland Department of Natural Resources Wildlife Administration Tawes State Office Building Annapolis, MD 21401 301-269-3195
STATE POLICY:	Maryland provides, on a limited basis, largemouth bass, bluegill sunfish, and sometimes trout fingerlings, free of charge, to private landowners. The fish may be used in newly constructed ponds for initial stocking; or for corrective stocking after an on-site visit by a staff biologist during early fall. Landowner must permit a reasonable amount of public fishing activity.
TO OBTAIN FISH:	Write contact (above).

Appendix D. (Continued).

O H I O

CONTACT:

Thomas E. Wasson, Supervisor
Fish Management & Research Group
Ohio Department of Natural Resources
Division of Wildlife
Fountain Square, C-4
Columbus, OH 43224
(614) 466-3630

STATE POLICY:

Ohio will provide free fingerling fish (bass, bluegills, catfish) for stocking into private ponds if the landowner or governmental agency has a pond meeting Division of Wildlife criteria, and the owner agrees to permit fishing by permission with a fishing license required.

TO OBTAIN AGREEMENT FORMS:

Write or call for a Cooperative Pond Fishing Agreement Procedure packet of information. If you know your county's wildlife district number, contact the fish management supervisor of the district involved. (Addresses below). Otherwise contact the Supervisor in Columbia (see above) who will process request to proper district.

Wildlife District One
1500 Dublin Road
Columbus 43215
Phone: (614) 466-3337

Wildlife District Two
952 Lima Avenue
Findlay 45840
Phone: (419) 422-6757

Wildlife District Three
912 Portage Lakes Drive
Akron 44319
Phone: (216) 644-2293

Wildlife District Four
360 E. State Street
Athens 45701
Phone: (614) 593-6933

Wildlife District Five
1076 Old Springfield Pike
Xenia 45385
Phone: (513) 372-7668

In Sandusky
Phone: (419) 625-8062

In Cleveland
Phone: (216) 621-7968

Appendix D. (Continued).

PENNSYLVANIA

CONTACT: The Pennsylvania Fish Commission does not stock nor provide fish for stocking privately-owned farm ponds or other small impoundments.

Appendix D. (Continued).

TENNESSEE

CONTACT:
Tennessee Wildlife Resources Agency
Fish Management Division
P.O. Box 40747
Nashville, TN 37204

STATE POLICY: In Tennessee, free fish (bass, bluegills, channel catfish) are available from hatcheries operated by both the State and the U.S. Fish and Wildlife Service. The private pond must meet certain criteria, and inspection may be necessary.

TO OBTAIN AGREEMENT FORMS: For fish from State hatcheries:

Write the Contact Agency (above), or if you know your wildlife district, obtain forms from district offices (see below). or from Game and Fish Officers. Request "Application for Assistance in Pond Management".

REGION I

Tennessee Wildlife Resources Agency
1186 Highway 45 By-pass
Director's Plaza
Jackson, Tennessee 38301

REGION II

Tennessee Wildlife Resources Agency
1231 N. W. Broad Street
Murfreesboro, Tennessee 37130

REGION III

Tennessee Wildlife Resources Agency
216 East Penfield Street
Crossville, Tennessee 38555

REGION IV

Tennessee Wildlife Resources Agency
1927 West Morris Blvd.
Morristown, Tennessee 37860

For fish from Federal hatcheries:

Available from county agents or from the Soil Conservation Service. Request "Fish Application".

Appendix D. (Continued).

VIRGINIA

CONTACT: The Virginia Commission of Game and Inland Fisheries does not furnish fish for private waters.

WEST VIRGINIA

CONTACT:
Robert L. Miles
Assistant Chief
Division of Wildlife Resources/
In Charge of Fish Management
West Virginia Department of Natural Resources
Charleston, WV 25305

STATE POLICY: West Virginia will provide free fish for stocking in privately owned waters where the Division of Wildlife has determined that such fish are necessary, and the water is open to unrestricted public fishing. The State will not provide nor sell fish for waters closed for public fishing.

TO OBTAIN AGREEMENT FORMS: Write Contact (above) for further information.

Appendix D. (Continued).

UNITED STATES DEPARTMENT OF THE INTERIOR
U. S. FISH AND WILDLIFE SERVICE
Division of Fish Hatcheries

Washington, D. C.

FHL-46-AL
Revised March 1975

ALABAMA DEALERS IN TROUT AND PONDFISHES

The list of dealers in this leaflet has been compiled by the U. S. Fish and Wildlife Service for the information of correspondents. The inclusion of names implies no endorsement as to quality and prices of the products handled.

LOCALITY	DEALER	SPECIES HANDLED
Aliceville	Pine Hill Catfish Farm James E. Craft 35442 373-2379	Catfish
Auburn	Auburn University E. E. Prather 36830 826-4786	Catfish
Clio	Easterlings' Fish Hatchery Bill Easterling 36017 347-4437	Catfish
Elmore	Elmore County Fish Hatchery Charles Watkings, Route #1, Box 15 36054 567-6787	Catfish
Fosters	Deep South Fisheries Buddy Fitts, Route #1 35463 752-0663	Catfish

Appendix D. (Continued).

Alabama (Continued).

LOCALITY	DEALER	SPECIES HANDLED
Fosters	Frog Ridge Catfish Farm Frank C. Crane, Route #1 35463 758-6081	Catfish
Ft. Payne	Mr. G. S. Horton 35967	Trout
Georgiana	Triple-M Catfish Farm Terry McInvale, Route #3, Box 362 36033 376-2866 or 376-9183	Catfish

Appendix D. (Continued).

Alabama (Continued).

LOCALITY	DEALER	SPECIES HANDLED
Greensboro	Stral Company, Bobby Collins, Box 548 36744 624-3061 or 624-8505	Catfish
Guntersville	Big Springs Minnow Farm J. B. Ratliff, Route #2 35976 773-2800	Catfish
Hartselle	Horace Roberts Catfish Farm 103 Bethel Road 35640 878-2976	Catfish
Levington	Mr. E. C. Harlan, Carver's Spring Trout Farm	Trout
Tallassee	Tallassee Catfish Company Jerry B. Denton, P.O. Box 217, 36078 283-4009	Catfish
Valley Head	Robert Brown 35989	Trout

Appendix D. (Continued).

ILLINOIS DEALERS IN TROUT AND PONDFISHES

The list of dealers in this leaflet has been compiled by the U.S. Fish and Wildlife Service for the information of correspondents. The inclusion of names implies no endorsement as to availability, quality, or prices of the products handled.

LOCALITY	DEALER	SPECIES HANDLED
Antioch	Sorenson's Bait Shop, Routes 173 & 59, Box 311 60002	LMB, BLG, BLC, Golden Shiner
Barrington	James B. Scoville, Route #1, Box 21 60010	Inquire of dealer
Bartelso	Mrs. Thomas Gebke Route #1 62218	Inquire of dealer
Beardstown	Rev. Frank Washburn 1001 Wall Street 62618	Inquire of dealer
Belleville	Adolph J. Haas 8700 Concordia Road 62221	Largemouth Bass
Bushnell	Lake Wildwood Haven 325 North Sperry 61422	Inquire of dealer
Camp Point	Ransom R. Butcher Box 43 62320	Inquire of dealer
Canton	Pete's Fishery, Peter Bertetto, 1153 South Avenue "B" 61520	RSF, SMB, LMB, WAE, NOP
Carbondale	Fountain Bluff Fish Farm 1211 Hill Street 62901	Golden Shiner
Carlock	Merle Peltz Route #1 61725	Inquire of dealer

Appendix D. (Continued).

Illinois (Continued).

LOCALITY	DEALER	SPECIES HANDLED
Carthage	Lake Linda, John Brooks Route #3 62321	Inquire of dealer
Cary	Lake Julian Trout Farm South Highway 14 60013	Inquire of dealer
Centralia	William L. Aydt Route #1 62801	Inquire of dealer
Chicago	Fish, Etc. -Bob Calfee 1015 W. Wellington, Rear Lakeview P.O. 60657	Inquire of dealer
Chicago	Tari Industries, Ltd. 3300 W. Cermak 60623	Inquire of dealer
Clay City	Virgil D. Shafer, P.O. Box 304 62824	Inquire of dealer
Cuba	Clayberg's Fish Farm 61427	Inquire of dealer
Des Plaines	Fisherman's Dude Ranch John M. Reding, 9600 Golf Road 60016	Inquire of dealer
Dow	Jim Seib Route #1 62022	Inquire of dealer
Dundee	McGraw Wildlife Foundation Box 194 60118	Inquire of dealer
Dwight	John B. Fitzpatrick, 214 East North Street 60420	Inquire of dealer
Evansville	Billy B. Veath Route #1 62242	Inquire of dealer

Appendix D. (Continued).

Illinois (Continued).

LOCALITY	DEALER	SPECIES HANDLED
Franklin Park	Wild Kingdom, Ltd. 3849 Carnation St. 60131	Inquire of dealer
Geneseo	Gen Deck Company 180 - Ill. 82 61254	Inquire of dealer
Gorham	Big Lake Fish Farm Don Whistle Route #1 62940	Inquire of dealer
Lemont	Patrick M. Magosky Rock Lk. North, Route #53 & Joliet Road 60439	Inquire of dealer
Litchfield	Samuel P. Pastrovich Sammy's Lake Route #2 62056	Inquire of dealer
McHenry	Boone Creek Springs Trout Farm, Robert L. Myers 5215 West Route #120 60050	Rainbow Trout
Millstadt	Howard & Ophelia Germann Spring Lake, 411 W. Harrison 62260	Inquire of dealer
Ramsey	Earl & Nelvin Wilson, Wilson Fish Farm, Route #1 62080	Inquire of dealer
Red Bud	Southern Illinois Bait Hatchery Route #1, Box 234 62278	Golden Shiner, Creek Chub
Richmond	Sportsmen's Experimental Farm, 7005 N. Pioneer Road 60071	NOP, BLG, BLC, YEP, Carp
Steward	Jack L. Heim, Route #1 60553	Inquire of dealer

Appendix D. (Continued).

Illinois (Continued).

LOCALITY	DEALER	SPECIES HANDLED
Tamaroa	Napier Frog Farm Route #2, Box 118A 62888	Inquire of dealer
Victoria	Gwebco, Inc. Reed Gibbs 61485	LMB, SMB, BLG, CCF, Golden Shiner, Bluntnose Minnow
Waterloo	H&H Fish Hatchery 526 S. Main 62298	Bluntnose Minnow, Golden Shiner
Waterloo	Walter L. Luhr Box 83 62298	Inquire of dealer
Waterloo	Clifford Wilder Route #4 62298	LMB, BLC, BLG, Sunfish, RSF, CCF
Wilmington	Howard's Fish Farm Howard Savage, Route #2, Box 50H 60481	Inquire of dealer
Worden	Opel's Fish Hatchery Box 51 62097	Inquire of dealer

INDIANA DEALERS IN TROUT AND PONDFISHES

The list of dealers in this leaflet has been compiled by the U.S. Fish and Wildlife Service for the information of correspondents. The inclusion of names implies no endorsement as to availability, quality, or prices of the products handled.

LOCALITY	DEALER	SPECIES HANDLED
Columbus	Woodrow Fleming R.R. 4 47201 812-372-2093	LMB, BLG, CCF, Redears, NOP, Trout
Greenfield	Greenfield Fishing Lakes & Hatcheries, R.R. 8, Box 127 46140 317-326-2496	LMB, BLG, RSF, CCF, Crappie, RBT, NOP, White Bass, Drum, Carp, Bullhead Catfish, etc.
Indianapolis	Jim Smith Live Fish 221 North Richland Street 46222 317-631-5598	LMB, BLG, CCF, Redear, Crappie, Trout, NOP, White Bass, Drum, Carp, Bullhead, Fathead, Blue Catfish, Burbot
Indianapolis	F. T. Yates & Son 3912 South Bridgeport Road 46231 317-241-9587	CCF, Carp, Bullheads
Martinsville	Clear Creek Fisheries Larry Hess, R.R. 4, Box 60 46151 317-342-2973	LMB, BLG, Redear, Crappie, CCF, Bullhead Catfish, FHM, Goldfish, Japanese Koi
Martinsville	Elmer Fowler, R.R. 2, Box 443 46151 317-342-4964	LMB, BLG, RSF

Appendix D. (Continued).

Indiana (Continued).

LOCALITY	DEALER	SPECIES HANDLED
Osgood	Cedar Creek Fisheries Russell A. Peace Route #2 47037 812-675-1783	CCF (Fingerlings), FHM
Osgood	Old Mill Fisheries Carl E. Demaree Route #3 47037 812-654-3458	LMB, BLG, RSF, CCF, Crappie
Seymour	Aquatic Control, Inc. P.O. Box 100 47274 812-497-2410	LMB, BLG, RSF, CCF, Crappie, Hybrid Sunfish, FHM

Appendix D. (Continued).

KENTUCKY DEALERS IN TROUT AND PONDFISHES

The list of dealers in this leaflet has been compiled by the U.S. Fish and Wildlife Service for the information of correspondents. The inclusion of names implies no endorsement as to quality and prices of the products handled.

LOCALITY	DEALER	SPECIES HANDLED
Barlow	Kendall C. Thomas 42024 224-2227	Catfish, Crappie, Bass
Calhoun	Livia Pay Lake, Inc. Sue E. Vandriver Route #1 42327 733-4929	Catfish, Carp, Bass, Buffalo
Calvert City	Lake Plaza Edwin Woldrop Route #1 42029 898-2857	Catfish
Caneyville	Donald O. Lindsey Route #2, Box 101 42721 596-2191	Catfish, Buffalo, Bass, Bluegill
Cromwell	Thomas S. Moore Route #1 42333	Catfish, Carp, Bluegill
Elizabethtown	Longview Bait, Inc. Route #8, Box 82 42701 769-2498	Catfish, Carp, Buffalo, Bluegill, Crappie, Bass
Flemingsburg	Wilburn Hamilton 109 Circle Drive 41041 845-1651	Catfish

Appendix D. (Continued).

Kentucky (Continued).

LOCALITY	DEALER	SPECIES HANDLED
Florence	Wm. & Kenneth Oberhelman 8312 Dixie Highway 41042 371-9358 or 371-5516	Catfish, Carp, BLG, Buffalo, Crappie, WAE, Bass, NOP, SAR, Trout, Redear
Georgetown	Billy Joe Shrout Route #1 40324 502-863-3817	Catfish, Carp, Buffalo, BLG, WAE, Bass, Drum, Crappie, Trout, WHB
Glasgow	Robert Mutter Route #2 42141 502-646-2106	Catfish, Carp, Buffalo, BLG, Crappie, Bass
Jeffersontown	John P. Riggs, 12709 Taylorsville Rd. 40299 267-5507	Catfish, Carp
Kenton	Kenton Lakes Charles G. Reimer Route #177 41053 356-3101	Catfish, Carp, Buffalo, BLG, SAR, NOP, Bass, Trout, Crappie
Kevil	J.O. Enlow Route #4 42053	Catfish
Kevil	Donald A. Hussey Route #3, Box 218A 42053	Catfish, Buffalo
Kevil	Roby C. Kight Route #2 42053	Catfish
Kevil	Orval Skinner, Route #4, Box 205 42053 734-4089	Catfish, Carp, Buffalo
LaCenter	James C. Harper Route #2 42056	Catfish, Buffalo

Appendix D. (Continued).

Kentucky (Continued).

LOCALITY	DEALER	SPECIES HANDLED
Louisville	Clarence Cox, P.O. Box 72186 40272 937-8069	Catfish
	Louisville Wholesale Bait 5113 Preston Hwy. 40213 968-8931	Catfish
Morgantown	Gaskey Bros. Pay Lake Karl & Billy Gaskey 42261	Catfish
Shelbyville	Claud Crittendon KY Live Fish Co. Route #3 40065 633-1800	Catfish, Carp, Buffalo, Bass
West Louisville	Diamond Lake Fish Farm Delbert Ginn 42377 684-6172	Catfish, Carp, Buffalo, Bluegill, Bass
Wickliffe	Ishmael H. Allen Route #1 42087	Catfish

Appendix D. (Continued).

Commercial Fish Dealers - MARYLAND

This list of commercial dealers was compiled by the Fish and Wildlife Service for the information of correspondents. The inclusion of names implies no endorsement as to quality and prices of the products handled.

LOCALITY	DEALER	SPECIES
Charlestown (Kent County)	Erwin W. McIntosh Box 131	Bass, Bluegills, Catfish
Frederick	Raymond Eaton 20701	Bass
Galena (Kent County)	Clinton J. Riley 21635	Bass, Bluegill
Gambrills (Anne Arundel Co.)	Charles E. Cox R.F.D. Box 485 21054	Bluegill
Worton (Kent County)	Fred Harbert 21678	Bass, Bluegill, Crappie
Worton	Robert M. Joiner R.F.D. 21678	Pike, Bluegills, Bass, Crappies, Catfish

Appendix D. (Continued).

OHIO DEALERS IN TROUT AND PONDFISHES

The list of dealers in this leaflet is provided by the U.S. Fish and Wildlife Service for the information of correspondents. The inclusion of names implies no endorsement as to quality, availability, or prices of the products handled.

LOCALITY	DEALER	SPECIES HANDLED
Ashtabula County (Orwell)	George Bookbinder, 436 E. Main Street	CCF, RBT
Belmont County (Powhatan Point)	Ray Brubaker, Route #1	LMB, SMB, BLG, Bullhead, CCF, BLC, White crappie, Minnows (Chub and others), Shiners (Emerald and others), YEP, BNT, RBT
Belmont County (St. Clairsville)	Frank Harris, Route #1	LMB, BLG
Butler County (Hamilton)	Leonard B. Harris, 2133 Hamilton-Cleves Road	LMB, SMB, WHB, BLG, CCF, BLC, MUE, YEP, NOP, WAE, RSF, BNT, RBT, Rock bass, Warmouth bass, Carp, White crappie, Crayfish, Dogfish, Garfish, Gizzard shad, Goldfish, Minnows (Bluntnose, Chub, Fathead, and others), Shiners (Emerald, Golden), Suckers, Sunfish, Bullheads

Appendix D. (Continued).

Ohio (Continued).

LOCALITY	DEALER	SPECIES HANDLED
Champaign County (St. Paris)	Paul C. Bodey, 7888 Millerstown-Eris Road	Crayfish, Minnow
Champaign County (Cable)	Mildred J. Wiant, 7942 Stevenson Road	LMB, SMB, Rock bass, Crayfish, Minnows (Bluntnose and others), Golden shiners
Clark County (Catawba)	Charles J. Boerger 305 N. Champaign	SMB, Bluntnose minnows
Clark County (South Vienna)	Milton Harold Clark, 8500 Jones Road	LMB, SMB, BLG, WHC, Crayfish, Minnows (Fathead, Bluntnose and others), Shiners (Golden and others)
Clermont County (Bethel)	James Riley, Buckskin Hatchery, R.R. 2, Box 430	LMB, BLG, CCF, BLC, WHC, NOP, WAE, RSF, BNT, RBT, Rock bass, Bullheads, Carp, Dogfish
Columbiana County (Lisbon)	Byron T. Bezdek, R.D. 3, 6354 Low Road	LMB, MUE, RSF, Golden Shiners, Minnows, Sunfish
Columbiana County (Salem)	Henry A. Maxim, R.D. 3	LMB, SMB, CCF, BLC, WHC, RBT, Sunfish, Georgia Shellcracker Bream (RSF)

Appendix D. (Continued).

Ohio (Continued).

LOCALITY	DEALER	SPECIES HANDLED
Columbiana County (Leetonia)	Leo Stoffer, R.D.1	LMB, SMB, WHB, BLG, NOP, WAE, RSF, BNT, RBT, Rock Bass, Sunfish, Warmouth Bass, Georgia Shellcracker Bream (RSF), Bullheads, CCF, Minnows, (Fathead, Bluntnose, Chub and others), Shiners (Emerald, Golden and others), Hybrid Sunfish
Coshocton County (Baltic)	Dennis Fender, Route #1	LMB, SMB, WHB, BLG, CCF, BLC, WHC, YEP, NOP, WAE, RSF, BNT, RBT, Rock bass, Warmouth bass, Bullheads, Carp, Crayfish, Goldfish, Minnows (Bluntnose, Chub, Fathead and others), Shiners (Emerald, Golden and others), Suckers, Sunfish
Coshocton County (Baltic)	John Richard Scherer Route #1	LMB, SMB, WHB, BLG, CCF, BLC, WHC, YEP, NOP, WAE, RSF, BNT, RBT, MUE, Rock bass, Warmouth bass, Bullheads, Crayfish, Goldfish, Minnows (Bluntnose, Chub and Fathead and

Appendix D. (Continued).

Ohio (Continued).

LOCALITY	DEALER	SPECIES HANDLED
		others), Shiners (Golden, Emerald and others), Suckers, Sunfish, Dogfish, Garfish, Gizzard Shad
Crawford County (Bucyrus)	Richard J. Gray, 626 W. Warren Street	LMB, BLG, Bluntnose, Minnows
Cuyahoga County (Fairview Park)	Richard T. Morgan, 21732 Lorain Road	LMB, SMB, CCF, BLC, WHC, RSF, Rock bass, Georgia Shellcracker Bream (RSF), Bullheads, Carp, Crayfish, Garfish, Goldfish, Minnows(Chub and others), Golden Shiners,Sunfish
Darke County (Greenville)	Wayne Lakes Park, Inc. 1054 Main Drive	LMB, BLG, Bullheads, BLC, WHC, YEP, RSF, Sunfish
Defiance County (Defiance)	Roger E. Vogel, Route #6	Channel Catfish
Erie County (Castalia)	Castalia Trout Club Co., Box 218	BKT, BNT, RBT
Fairfield County (Lancaster)	John W. Campbell, 1815 Cedar Hill Road	Minnows(Bluntnose, Fathead and others), Shiners (Emerald, Golden and others)
Gallia County (Konauga)	William H. Reynolds, Sr., 135 River Street	Minnows(Fathead and others), Shiners
Greene County (Fairborn)	Helen Conant, P.O. Box 181	BLG, CCF, BLC, FHM, Golden Shiners,YEP, NOP

Appendix D. (Continued).
Ohio (Continued).

LOCALITY	DEALER	SPECIES HANDLED
Guernsey County (Byesville)	Robert S. Kirkman, Route #1, Box 150	LMB, BLG, CCF, BLC, WHC, YEP, BNT, WAE, RBT, Rock Bass, Warmouth Bass, Bullheads, Crayfish, Sunfish
Hamilton County (Cincinnati)	James O. Denier, 3684 Pool Road	Goldfish
Hamilton County (Cincinnati)	James Lewis 3727 W. Galbraith Road	LMB, BLG, CCF, BLC, WHC, Carp, Minnows, Sunfish
Hamilton County (Cincinnati)	Walter White, 8315 Beechmont Avenue	Minnows
Holmes County (Loudonville)	Don E. Cleghorn, R. D. 1, Box 29	Rainbow trout
Holmes County (Millersburg)	Roy R. Milier, Box 83	Largemouth bass
Holmes County (Glenmont)	John Skalsky	LMB, SMB, RBT, Georgia Shellcracker Bream (RSF), Minnows (FHM and others)
Huron County (New London)	Louis Calala, R. D. 2, Route 60N	LMB, SMB, BLG, CCF, Crayfish, Emerald Shiners, Minnows
Huron County (Greenwich)	Thomas W. Palmer, R. R. 1	LMB, SMB, BLG
Jackson County (Oak Hill)	Olen Roberts, Route #2	LMB, BLG, CCF, BLC, Bullheads, Crayfish, Minnows (FHM and others), Golden Shiners

LOCALITY	DEALER	SPECIES HANDLED
Knox County (Fredericktown)	Joseph C. Linkous, Route #3	Walleye pike, BNT, RBT
Lake County (Kirtland)	John W. Cory, 9020 Chardon Road	LMB, WHB, CCF, YEP, BNT, Rock bass, Georgia Shellcracker Bream (RSF), Carp, Garfish, Minnows, Sunfish
Lawrence County (Coal Grove)	Charles W. Eicher, 109 Pike Street	LMB, SMB, BLG, BLC, WHC, Bullheads, Carp, Crayfish, Goldfish, Minnows(FHM and others), Shiners (Emerald, Golden, and others), Suckers
Licking County (Granville)	Gaile Davis, Route #2	LMB, BLG
Licking County (St. Lewisville)	Jan Michelek, Route #1	BNT, RBT
Logan County (Zanesfield)	Jerry C. Lyon, Route #1	Rainbow trout
Lorain County (Grafton)	G. E. Bamrick, 1029 Sunshine Ct.	LMB, Rock bass, WHB, Georgia Shellcracker Bream (RSF), Carp, Bullheads, CCF, WHC, Minnows (Bluntnose, Chub, FHM, and others) Shiners(Emerald, Golden and others), YEP, NOP, RSF, BNT, RBT, WAE
Lorain County (Lorain)	George A. Garwell, 4850 W. Erie Avenue	Crayfish, Emerald Shiners, Minnows

Appendix D. (Continued).
Ohio (Continued).

LOCALITY	DEALER	SPECIES HANDLED
Mahoning County (Poland)	Steve Antonoff, Jr., 1697 W. Western Road	LMB, Georgia Shellcracker Bream (RSF), Bullheads, Carp, CCF, BLC, WHC, YEP, WAE, BNT, RBT
Mahoning County (Diamond)	Earl W. Bartel, 2236 S. Newton Falls Road	LMB, Warmouth bass, Georgia Shellcracker Bream (RSF), Bullheads, CCF, BLC, WHC, Garfish, Minnows(Chub, FHM and others), Golden Shiners, Sunfish
Mahoning County (Canfield)	Richard A. Calvin, 2705 W. Calla Road	LMB, Warmouth bass, Georgia Shellcracker Bream (RSF), Bullheads, CCF, BLC, WHC, FHM, YEP, RSF, RBT, Sunfish
Medina County (Medina)	Charles Boston, 3148 Sharon-Conley Road	LMB, Rock bass, SMB, Warmouth bass, WHC, BLG, Georgia Shellcracker Bream (RSF), Bullheads, Carp, Catfish (Blue, CCF, Mud, Shovelhead), Crappie (BLC, WHC), Crayfish, Dogfish, Frogs, Garfish, Gizzard Shad, Goldfish, Minnows(Bluntnose, Chub, FHM and others), Sucker, Shiners(Emerald, Golden and others), MUE, YEP, NOP, WAE, Sunfish, Hybrid Sunfish, RSF, Trout, (BKT, BNT, Kamloops, RBT and others)

LOCALITY	DEALER	SPECIES HANDLED
Medina County (Medina)	Hill'Dale Club, 3605 Poe Road	LMB, Rock bass, SMB, Georgia Shellcracker Bream (RSF), Carp, Bullheads, CCF, BLC, WHC, Minnows (Chub, Bluntnose, FHM and others), Shiners (Emerald, Golden and others), YEP, NOP, WAE, RBT
Medina County (Medina)	Albert Hood, 3606 Remsen Road	LMB, SMB, Georgia Shellcracker Bream (RSF), CCF, WHC, Gizzard Shad, FHM, Golden Shiners, YEP, NOP, WAE; RSF
Medina County (Hinckley)	Dennis C. Maier, W. Drive Parkway	Minnows(Bluntnose, Chub, FHM and others), Shiners(Emerald, Golden and others)
Medina County (Medina)	John Moxley, 3675 Poe Road	LMB, BLG, CCF, Bullheads, Minnows(Bluntnose and others), Shiners (Emerald, Golden and others), Sunfish, Hybrid Sunfish, RSF
Mercer County (Celina)	Herbert H. Dammeyer & Robert F. Speckman, Route #5	Crayfish, FHM
Mercer County (Celina)	Ernest Hein, R. R. 2, Box 83	Bluntnose Minnows, FHM
Mercer County (Celina)	Opal A. Hight, 107 S. LeBlond Street	Crayfish, Bluntnose Minnows

Appendix D. (Continued).

Ohio (Continued).

LOCALITY	DEALER	SPECIES HANDLED
Miami County (Piqua)	Burgess E. Weddle, 439 Vine Street	Crayfish, Bluntnose Minnows, Chub Minnows, FHM, Shiners, Suckers
Morrow County (Mt. Gilead)	Robert Jones, R. F. D. 3, Co. Road 14	LMB, SMB, BLG, BLC, WHC, YEP, Sunfish, RBT
Ottawa County (Port Clinton)	Winous Point Shooting Club, 3500 Lattimore Road	BLG, BLC, WHC, RSF, Bullheads, Carp, Dogfish, Goldfish, Sunfish, Hybrid Sunfish
Portage County (Kent)	William M. Gressard, 759 Ravenna Road	LMB, Georgia Shellcracker Bream (RSF), BLC, Minnows, Golden Shiners, Sunfish, RSF
Preble County (Somerville)	Fred Bley, 1215 Somerville W. Elkton Road	LMB, BLG, CCF, RSF, Carp, Sunfish
Preble County (Somerville)	Charles Haddix, 6932 Greenbush	LMB, SMB, BLG, CCF, Minnows (Chub and others), Shiners (Golden and others), YEP, RBT
Richland County (Mansfield)	Lester L. Hampton, 985 S. Diamond Street	LMB, BLG, BLC, WHC
Shelby County (Botkins)	Wayne Roediger, Bait & Fish Hatchery, Inc., R. R. 1	LMB, SMB, BLG, CCF, BLC, FHM, YEP, NOP, WAE, RBT, Bullheads, Goldfish, Emerald Shiners, Golden Shiners
Stark County (Canton)	Thomas S. Evans, 1445 Spring Valley Rd., N. W.	LMB, BLC, RSF, Georgia Shellcracker Bream (RSF)

Appendix D. (Continued).

Ohio (Continued).

LOCALITY	DEALER	SPECIES HANDLED
Stark County (Alliance)	Edward O. Ganslein, 234 Maplewood Drive	Rainbow trout
Stark County (Canal Fulton)	William E. Lyons, 6342 Manchester Ave., N. W.	Georgia Shellcracker Bream (RSF)
Stark County (N. Canton)	Roy C. Sunderland, 240 Oak Drive	Channel Catfish
Summit County (Akron)	James Lupori, 1155 Tulip Street	Crayfish, Bluntnose Minnows
Trumbull County (Fowler)	Julia Benning, St. Rt. #5 Cadwallader	Bluntnose Minnows, Golden Shiners
Trumbull County (W. Farmington)	Homer O. Dillon, R.D. 1	LMB, SMB, CCF, FHM, WAE, RSF, Georgia Shellcracker Bream (RSF), Crayfish, Golden Shiners, Sunfish
Tuscarawas County (Dundee)	Paul W. Shepherd, R.D. 2	LMB, SMB, BLC, Rock bass, Warmouth bass, Georgia Shellcracker Bream (RSF)
Union County (Marysville)	Frank C. Miller, R.F.D. 5	LMB, BLG, CCF, Bluntnose Minnows
Warren County (Morrow)	Cletus Switzer, Switzer Bros., R.R. #1	LMB, BLG, CCF, BLC, WHC, YEP, RSF, RBT, Rock bass, White bass, Bullheads, Carp, Suckers, Sunfish
Washington County (Vincent)	Clinton V. Bogard, Route #1	BLG, CCF, FHM, Goldfish, Golden Shiners

Appendix D. (Continued).

Ohio (Continued).

LOCALITY	DEALER	SPECIES HANDLED
Wayne County (Burbank)	Phillip Boreman, R.D.1	LMB, SMB, BLC, WHC, YEP, NOP, Georgia Shellcracker Bream (RSF), Minnows, Sunfish
Wayne County (Doylestown)	Thomas Knighton, 512 Church Street	LMB, CCF, RBT, Georgia Shellcracker Bream (RSF)
Wayne County (Doylestown)	Clarence Rohr, R.D. 1	LMB, CCF, Georgia Shellcracker Bream (RSF), Bullheads
Wayne County (Wooster)	Gerald E. Yates, R.D. 2	LMB, SMB, Georgia Shellcracker Bream (RSF)
Wood County (Stony Ridge)	Jack Rodemich, P.O. Box 277	LMB, SMB, BLG, Warmouth bass

Appendix D. (Continued).

Commercial Fish Dealers - PENNSYLVANIA

This list of commercial dealers was compiled by the Fish and Wildlife Service for the information of correspondents. The inclusion of names implies no endorsement as to quality and prices of the products handled.

LOCALITY	DEALER	SPECIES
Allentown	E.C. Morgan 720½ Tilgham St. 18100	Bass, bluegill
Austin	Littlefelders Trout Hatchery Route 872 16720	Trout
Bangor	Charles E. Williams, Greenwalk Trout Hatchery, 36 N. 5th St. 18013	Trout
Cambridge Springs	Blair Schiller, Route 3 16403	Bass, bluegill
Coudersport	Rainbow Paradise Trout Farm, Clair and Helen Tingley, RD #4 16915	Trout
Cresco	Paradise Brook Trout Company, George F. Stack 18326	Trout
Drifting	Zetts Fish Hatchery, Andrew Zetts, Jr. 16834	Trout
Everett	Fish-Grow Fisheries, William Johnson, P.O. Box 87 15537	Bass, Bluegill
Farmington	Farmington Game Farm Louis V. Scarnecchia 15437	Trout
Florin	The Florin Anglers Club 17552	Trout
Fombell (Beaver County)	J.M. Cunningham Enterprises RD #1 16123	Bass, sunfish
Glenside	Brookdale Trout Hatchery George Kass & Company 2627 Mt Carmel Avenue 19038	Trout

Appendix D. (Continued).

Pennsylvania (Continued).

LOCALITY	DEALER	SPECIES
Grampian	Popular Run Trout Hatchery Ansel Thomas 16838	Trout
Grantville (Dauphin Co.)	Blue Ridge Mt. Trout Lakes Claude C. Hetrick 17028	Trout
Greensburg	James Piazza, 136 W. Pgh. St. 15601	Trout
Guys Mills (Crawford Co.)	Frank E. Werner, RD #2 16327	Trout
Hallstead	John Harasymczuk, RD #1 18822	Catfish
Hanover	A.C. Mudge, 120 Black Rock Road 17331	Trout
Harmony (Butler Co.)	Sherwood Oakes Hatchery Francis A. Lazor, RD #1 16037	Bass
Hawley	Blooming Grove Hunting and Fishing Club 18428	Trout, bass
Hawley	Carl W. Badenhausen, RD #1, Box 101 18428	Trout
Honesdale	Lester C. Perry, Star Route 18431	Catfish
Jacobus	Robert E. Franklin, Box F 17338	Golden Orf
Latrobe	Possum Hollow Lakes Harry Luttner, RD #1, Box 187 15650	Trout
Lehighton	Kriss Pines Trout Hatchery Lillie & Joseph Kriss RD #4 18235	Trout
Ligonier	Idlewild Bluegill Hatchery 15658	Bass, sunfish

Appendix D. (Continued).
Pennsylvania (Continued).

LOCALITY	DEALER	SPECIES
Ligonier	Donald & Victor Smith RD #2 15658	Bass
Ligonier	Rolling Rock Club 15658	Trout
Mercersburg	Mt. Parnell Fisheries 17236	Goldfish
Meyerstown	Tulpehocken Rod and Gun Club	Trout
Mill Hall	Cedar Springs Trout Hatchery Albert Tomalonis, RD #1 17751	Trout
Mount Joy	The Florin Anglers Club RD #1 17552	Trout
Mount Pleasant	Greenlick Trout Hatchery RD #1, Box 166, Miles Angelo 15666	Trout, catfish
Naticoke	John Pecil, 109 Espy Street 18634	Sunfish
New Cumberland	Elmer C Ream, 201 Summit Ave. 17070	Trout
Nemanstown (Clarion County)	Krystal Kleer Trout Hatchery L.M. Keener 17073	Trout
New Providence (Lancaster Co.)	Hiram Peoples Hatchery 17560	Bass, sunfish
Newton Square (Delaware Co.)	John D. Burnham, RD #1 19073	Bass
Newville	The Green Spring Co., RD #2 17241	Trout
Oley	Lobachsville Trout Farm Dr. Arthur G. Eshenaur RD #11 19547	Trout
Oley (Berks Co.)	Claude Hartman, RD #1 19547	Bass, sunfish

Appendix D. (Continued).
Pennsylvania (Continued).

LOCALITY	DEALER	SPECIES
Perkasie	Harold D. Knieriem M.R. #1, W. Rock Road 18944	Bass, sunfish
Penn Run	Eastern Orthodox Foundation 15765	Bass, sunfish pike, perch
Port Allegheny	Crystal Springs Brook Trout Co., Inc., RD #2 16743	Trout
Reading	Reading Eagle Co. 345 Penn Street 19601	Trout, Bass, Sunfish
Reedsville	Coffee Run Hunting & Fishing Club 17084	Trout
Richland	Limestone Spring Trout Hatchery, John E. Gingrich 17087	Trout
Saylorsburg	Kathryn I. Kostenbader RD #1 18353	Trout
Seelyville (Wayne County)	Edward A. Green 825 Maple Avenue 18431	Catfish
Shippensburg	Strohm's Trout Hatchery 242 E. King Street 17257	Trout
Silver Spring	Nolt's Ponds, Lloyd W. Nolt 17575	Goldfish
Slippery Rock	Mr. Oliver Huey, RD #1 16057	Carp
Somerset	Laurel Hill Trout Hatchery RD #6, Clair J. Basset 15501	Trout, bass
Somerset	Shaffer Run Trout Hatchery 15501	Trout
Somerset	Big Springs Farm, Hans E. Musser, RD #6 15501	Trout
Spruce Creek (Huntingdon Co.)	Spruce Creek Trout, Inc. 16683	Trout

Appendix D. (Continued).

Pennsylvania (Continued).

LOCALITY	DEALER	SPECIES
St. Mary's	Jimunandy Park Fish Hatchery Andrew Kaul, III 15857	Trout
St. Mary's	Stackpole Carbon Company 15857	Trout
Stroudsburg	Pohoqualine Fish Association RD #5 18360	Trout
Stroudsburg	Cherry Valley Trout Hatchery Merrill J. Reddinger, RD #4 18360	Trout
Summit Hill	Jerome J. Citro 404 W. Ludlow Street 18250	Trout
Tunkhannock	Sugar Hollow Trout Hatchery William R. Williams 18657	Trout
Tunkhannock	C. R. Brown, RD #5 18657	Bass
Utica (Venango Co.)	Jenkins Trout Hatchery 16362	Bass, trout
Volant (Lawrence Co.)	Jesse Cornelius, RD #3 16156	Trout
Wampum (Lawrence Co.)	Fred Schoeffell, RD #2 16157	Trout
Waymart	James P. Reilly, RD #3 18472	Bass, sunfish
Williamsburg	Seven Falls Angler's Club, Inc., RD #1 16693	Trout
Worthington	Herbert E. Smith & Sons RD #2 16262	Bass, sunfish

Appendix D. (Continued)

Pennsylvania (Continued)

LOCALITY	DEALER	SPECIES
Zion Grove (Schuylkill Co.)	Zion Grove Trout Hatchery Edward Tomalonis 17985	Trout
Zionsville (Lehigh Co.)	Joseph T. Seem, RD #1 18092	Bass

Appendix D. (Continued).

TENNESSEE DEALERS IN TROUT AND PONDFISHES

The list of dealers in this leaflet has been compiled by the U. S. Fish and Wildlife Service for the information of correspondents. The inclusion of names implies no endorsement as to quality and prices of the products handled.

LOCALITY	DEALER	SPECIES HANDLED
Bethel Springs	L. W. Hipps 38315	Catfish
Centerville	James A. Hutchison Route #2 37033	Inquire with dealer
Clarksville	Franciszek and Ruby Pyclik, Route #2, Box 428 37040	Inquire with dealer
Clinton	Luther H. Stooksbury Route #5 37716	Trout
Elizabethton	L. B. Watson Route #8 37643	Trout
Hornbeak	Bill H. Hall Route #1 38232	Hybrid sunfish, Bass, Israeli carp, Catfish
Humboldt	Mrs. Byron Nethery, 917 18th Avenue, N. 38343	Catfish
Murfreesboro	W. D. Fretz, 72 Oriental Gardens 37130	Inquire with dealer
Savannah	Jesse J. Clement Route #2 38372	Catfish
Scotts Hills	Eli Taylor Route #1 38374	Catfish

Appendix D. (Continued).

Tennessee (Continued).

LOCALITY	DEALER	SPECIES HANDLED
Selmer	U.P. Rowland Route #1 38375	Catfish
Selmer	E. L. Forsyth, Forsyth Lakes, Route #3, Box 24 38375	Catfish
Waynesboro	Ford Griggs 7-Springs Fish Farm Route #4, Box 175 38485	Inquire with dealer
Waynesboro	Joseph V. Lay Lay's Catfish Farm Route #2 38485	Catfish
Whiteville	Julius Sammons, Jr. Sammons Catfish Farm Route #2 38075	Catfish

Appendix D. (Continued).

Commercial Fish Dealers - VIRGINIA

This list of commercial dealers was compiled by the Fish and Wildlife Service for the information of correspondents. The inclusion of names implies no endorsement as to quality and prices of the products handled.

LOCALITY	DEALER	SPECIES
Charles City	J. C. Smith, Route 1 23030	Catfish
Craigsville	Casta Line Trout Farm 24430	Trout
Maurertown (Shenandoah Co.)	Orndorffs Rainbow Trout Farm Star Route 22644	Trout
Monterey	Virginia Trout Company Box 2 24465	Trout
Munden	Ernest Grinstead 23457	Bass, bluegill
New Castle	W. P. Adams Route #1, Box 23 24127	Trout
Rural Retreat	Cedar Spring Trout Farm Route 1, Box 296	Trout
Virginia Beach	Willie P. Davis, Shipps Road Hills Landing, Back Bay Station 23457	Bass, bluegill
Virginia Beach	Murden's Club, Horn Point Club Road, Back Bay Station 23457	Bass, bluegill
Virginia Beach	E. T. Saunders, Back Bay Station 23457	Catfish
Yorktown	Dixie Fisheries, W. Sulik 23490	Catfish

Appendix D. (Concluded).

Commercial Fish Dealers - WEST VIRGINIA

This list of commercial dealers was compiled by the Fish and Wildlife Service for the information of correspondents. The inclusion of names implies no endorsement as to quality and prices of the products handled.

LOCALITY	DEALER	SPECIES
Elkview (Kanawha County)	KenTrigaux, Route 3, Box 194, 25071	Bass and Bluegill
Franklin	Mountain State Trout Hatchery Box 341, 26807	Trout
Hinton	Howard C. Fox, Hix Route 25951	Bass, bluegill, catfish
Huntington	H. Blakenship, Box 2284 25307	Bass and bluegill
Hurricane	C.W. Jones, Teays Valley 25526	Bass and bluegill
Princeton	Mercer Anglers Club Box 1027, 24740	Trout
Richwood	James Wolverton, Box 629 26261	Trout
Scherr (Grant County)	Sprotsmens Paradise 27726	Trout
Terra Alta	Mountaintop Vacationland 26764	Trout

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16. Abstract (Limit: 200 words)

Volume II of this two-volume reference manual is intended primarily for use by reclamation planners and managers as a general reference document. It also may be useful to coal mine operators, landowners, farmers, administrators, and other individuals or groups, such as sportsmen's clubs interested in protecting, enhancing and managing fish and wildlife on surface mined lands in the East. It identifies some of the opportunities for fish and wildlife planning and management in connection with various methods of surface mining for coal and the reclamation and management of surface-mined lands. It suggests approaches for management to enhance fish and wildlife in differenct regions and under different conditions, using real-life or hypothetical case examples. It further illustrates what productive habitat for various kinds of wild animal communities looks like at different stages of development. Appendices in Volume II illustrate a worksheet used for assigning reclamation priority and main benefits for SCS-related projects, identify plant species and provide sources of planting stock and seed for habitat development on surface-mined areas, and list contacts for obtaining fish for stocking impoundments.

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

March 3, 1849

U.S.
FISH & WILDLIFE
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